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ABSTRACT

This document was designed to help Idaho schools with their development of a K-12 mathematics curriculum and program, and to assist in formulating some realistic goals for themselves and their students. The bulk of the document contains mathematics education standards for each of the grades K-8 and for grades 9-12 as a unit and includes goals, performance objectives, and sample progress indicators for each standard. Included for grades 4 and 8 are sample performance assessment items and Idaho performance scoring standards. Also included are: (1) a listing of major shifts in emphasis from current programs, (2) Idaho goals for mathematics, (3) questions and answers on performance-based education, (4) curricular frameworks and alignment, (5) a mathematics goals/exit performance standards matrix, (6) mission and vision statements, and (7) position statements on vocabulary, resource availability, calculator usage, and staff development. Contains 23 references. (MKR)

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# IDAHO
# K-12 MATHEMATICS
# CONTENT
# GUIDE AND FRAMEWORK

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# IDAHO

# K-12 MATHEMATICS CONTENT

# GUIDE AND FRAMEWORK

1994

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## K-12 MATHEMATICS CONTENT GUIDE AND FRAMEWORK

## ACKNOWLEDGMENTS

The State Department of Education sincerely appreciates the professionalism, expertise, and effort of the "Framework Writing Team." The team accepted the responsibility of developing a guide for excellence in mathematics education for Idaho's students, teachers, parents, and schools. Without the team's contribution to the development of this document, the guidance provided would fall far short of meeting the needs of Idaho's students.

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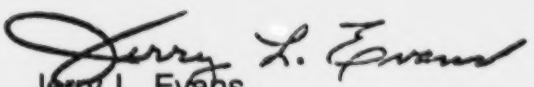
## FOREWORD

In October of 1993, a 15 member writing committee was assembled to write Idaho's K-12 Mathematics Content Guide and Framework. The committee was composed of educators involved in classroom teaching from the kindergarten through 12th grade level, administrators and college level personnel, and staff of the State Department of Education. Resources from various states, Idaho's performance based education documents, state-approved mathematics textbooks, as well as input from our local school districts, were used to write Idaho's framework.

This framework has been designed to help schools with their development of a mathematics curriculum and program, and to assist in formulating some realistic goals for themselves and their students. It is not our purpose to outline methods and procedures nor to recommend activities, projects, units, or plans for students and teachers. These are adequately treated in the teacher manuals of state-adopted textbooks and curriculum frameworks developed by local districts. However, the State Department of Education recommends that all Idaho public school districts use this framework as a basic resource.

I commend each person who participated in the writing of this framework. This document should serve the public schools well and ensure quality mathematics instruction for Idaho students.



Jerry L. Evans
State Superintendent
of Public Instruction

This document is intended to be a working implementation resource for schools, teachers, and patrons as the school develops its mathematics program. For the coming year, this document is considered to be open for review and revision. The State Department of Education invites comments from students, teachers, administrators, and parents. Please feel free to forward any comments regarding this document to:

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OUR STANDARDS SHOULD REPRESENT BROAD MAJOR SHIFTS IN EMPHASIS FROM CURRENT PROGRAMS. THE SHIFTS INCLUDE.....

| FROM.... | TO.... |
|---|---|
| A NARROW TEXTBOOK/LECTURE DRIVEN CURRICULUM | A BROAD CURRICULUM THAT INCLUDES EXPERIENCES NOT ONLY IN ONE CONTENT BUT CROSS-CURRICULAR. |
| AN ACQUISITION OF PIECES OF KNOWLEDGE AS AN END IN ITSELF | EMBEDDING KNOWLEDGE IN A CONCEPTUAL FRAMEWORK AS A PROBLEM SOLVING TOOL. |
| A NARROW ROLE FOR PROBLEM SOLVING WITH PROBLEM SOLVING BEING WORD PROBLEMS | PROBLEM SOLVING AS A CENTRAL FOCUS TO LEARNING. |
| PREOCCUPATION WITH PENCIL-PAPER DRILL AND DRUDGERY | MULTIPLE METHODS OF COMMUNICATION, COMPUTATION, AND METHODS DEMONSTRATING LEARNING. |
| EMPHASIS ON SEPARATE AREAS OF CONTENT | CONNECTIONS BETWEEN DISCIPLINES AND THE CONTENT TRADITIONALLY LEARNED IN THOSE DISCIPLINES. |
| EMPHASIS ON ONE RIGHT ANSWER | EMPHASIS ON STUDENT'S REASONING AND PROBLEM SOLVING PROCESSES. |
| STUDENTS AS PASSIVE PARTICIPANTS | STUDENTS AS ACTIVE PARTICIPANTS IN CONSTRUCTING IDEAS THROUGH EXPLORING, INVESTIGATING, DISCUSSING, AND CONJECTURING. |
| TEACHERS AS TRANSMITTERS OF KNOWLEDGE | TEACHERS AS FACILITATORS OF LEARNING. |

....AND....

EVALUATION AND ASSESSMENT AS A MEANS OF IMPROVING INSTRUCTION, LEARNING, AND PROGRAMS. ALSO....USING A VARIETY OF EVALUATION TECHNIQUES. USING A STANDARDIZED TEST AS ONLY ONE OF MANY INDICATORS.

## DEFINITIONS

**Following are definitions of some of the educational vocabulary as used in this document.**

**CONTENT GUIDE** -- The described necessary content that is most compelling in a discipline. It covers the basic skills and all the concepts that leads to what it is a student should know and be able to do at the various levels of the discipline.

**FRAMEWORK**-- A design that "frames" a series of critical components describing what we teach and how we assess it. Gives "unity" to what we do in that discipline. It is hoped that the state framework provides a model for school districts to use in their development of district frameworks that could also describe how a concept will be taught.

**STRAND** -- One learning segment of a standard.

**STANDARD** -- A broad description of what a student should know and be able to do.

**GOAL** -- A broad description of what is important in achieving proficiency in a standard.

**OBJECTIVE** -- A specific statement that describes what will be learned to reach the goal.

**BENCHMARK** -- A description of what a student should know and be able to do at a specified time. In Idaho, that time has been established at the 4th, 8th, and 12th grade levels.

**SAMPLE PROGRESS INDICATOR** -- Problems or situations that teachers and students may use to assess and demonstrate student capability and performance. Performance on progress indicators will help students establish progress toward benchmark achievement within a standard and on the performance assessments administered at the 4th, 8th, and secondary levels.

**PERFORMANCE ASSESSMENT EXAMPLES** -- A set of problems or situations that model similar problems or situations that will be found in the performance assessment administered at the 4th, 8th, and secondary levels.

**PERFORMANCE ASSESSMENT SCORING STANDARD** -- The holistic or analytical scoring devise that will be used to score a performance assessment. Consists of a scoring standard and the traits that must be exhibited to demonstrate achievement at that scoring standard.

**EXIT PERFORMANCE STANDARDS** -- The final established benchmark describing a student as he/she exits our school at the 12th grade. Describes quite precisely what it is you want the student to know and be able to do when they exit the system.

**PERFORMANCE ASSESSMENT** -- An assessment where students must demonstrate what they know and are able to do.

## IDAHO GOALS FOR MATHEMATICS

**GOAL 1** **All students will have equal access to instruction and the study of mathematics.**

*Students must be provided the necessary facilities and resources, from buildings to calculators, to ensure the opportunity to study and learn mathematics.*

**GOAL 2** **All students will be exposed to the importance of mathematics in the world of work.**

*Students must see where and how mathematics plays a vital role in careers.*

**GOAL 3** **All students will learn to value mathematics.**

*Students need numerous experiences related to the cultural, historical, and scientific evolution of mathematics so that they appreciate the role of mathematics in the development of society.*

**GOAL 4** **All students will become confident in their own mathematical abilities.**

*Mathematics is a common human activity, and as a result of studying mathematics students will have the power to make practical application of that knowledge.*

**GOAL 5** **All students will learn to reason mathematically.**

*Making conjectures, gathering data, and building arguments are fundamental to doing mathematics, so much so that demonstration of good reasoning should be rewarded even more than an ability to find correct answers.*

**GOAL 6** **All students will become mathematical problem solvers.**

*Students' ability to solve problems is essential to being productive citizens.*

**GOAL 7** **All students will learn to communicate mathematically.**

*Students' power to use mathematics is best accomplished in problem situations that require reading, writing, and discussing in concert with the manipulation of necessary symbols.*

## QUESTIONS AND ANSWERS ON PERFORMANCE BASED EDUCATION

### Why should Idaho change to performance based education?

The world is changing. As our society moves from the industrial age to the information age, schools must be redesigned to prepare students for the future. To be successful, students must become life-long learners who can work with others, communicate clearly, apply what they have learned in practical ways, recognize quality, and be creative and original problem solvers. Performance based education ensures that students master both traditional basic skills (phonics, reading, writing, math, spelling. grammar, social studies, and science inquiry) and additional basic skills that emphasize application and use of what has been learned.

### What is performance based education?

Performance based education clearly defines what students are expected to know and be able to do with that knowledge. Students are periodically tested or assessed to determine their progress, and each student is given needed time and assistance to become proficient. Students who show meaningful progress or skill development are advanced to more challenging material.

### What are additional basic skills?

In Idaho we call them *exit performance standards*. We believe that besides demonstrating proficiency in the traditional basics, students who graduate from Idaho high schools must be able to

1) communicate clearly and effectively.
2) use knowledge and information effectively.
3) solve problems.
4) be creative and original.
5) determine quality.
6) work cooperatively with others. And
7) learn effectively throughout life.

These *exit performance standards* are additional basics that students must acquire in order to live and work in a complex and changing world.

### How is performance based education different from traditional teaching methods?

In traditional methods, teachers present material, students study and do homework, students are tested, the grades are recorded, and the class moves on to the next topic--whether or not everyone has learned the information.

In performance based education, a student must demonstrate what they know and are able to do in a given discipline. Thus performance based education is more attentive to the individual student's progress.

### Does performance based education "dummy down" the curriculum so that all students are learning less?

Just the opposite. Performance based education sets uniform standards for all students. To show proficiency, a student has to meet a rigorous predetermined standard. Because the standards set high expectations for all students, students will learn more. Idaho's own Direct Writing Assessment program, now in its 10th year, is a good example: the quality of students' writing has improved during this time because the tough standards go hand-in-hand with solid preparation.

### How does performance based education teach students to think?

Performance based education requires students to analyze, synthesize, evaluate, internalize, and apply what they have learned. Students are also taught to evaluate their own progress and set goals for improvement.

### What are the differences between traditional testing and performance based assessment?

A traditional pencil and paper test requires that students show what they have learned. They do not have to demonstrate what they can do with what they know, and they are not able to demonstrate the depth and breadth of their knowledge. Often grades are reported as the percentage of test questions answered correctly.
It is possible to receive credit by mastering as little as 60 percent of the information (usually a "D").

In a performance assessment, students are expected to answer two questions: *What do you know?* and *What can you do with what you know?* Students show their basic knowledge and understanding through a variety of activities that demonstrate their level of proficiency. This kind of assessment not only requires thorough knowledge of the basic skills, but demands that students demonstrate this knowledge through projects, performances, experiments, research, essays, critiques, and other practical ways.

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## What are performance based assessment standards?

Performance based assessment standards describe the student's level of proficiency in meeting the *exit performance standards*:

4) **Advanced:** The student goes beyond the basic requirements, demonstrates a thorough understanding of the exit performance standards, and communicates those concepts clearly and easily.

3) **Proficient:** The student meets the basic requirements and communicates these concepts clearly and easily.

2) **Developing Toward proficiency:** The student meets some, but not all, of the basic requirements. He or she has difficulty in communication.

1) **Minimum Development Toward Proficiency:** The student meets few of the basic requirements set forth in the *exit performance standards* and is unable to communicate in a clear and thoughtful way.

## How will changing to performance based assessment effect classroom teaching?

Classrooms of the future may look quite different. Instead of the teacher standing in front of the room lecturing for 50 minutes, students will work separately--and together--to produce products (writing portfolios, art portfolios, exhibits, plays, poems, science experiments, math demonstrations) or performances (typing tests, dramatic and musical performances, or oral debates). The teacher will decide on the content and purpose of each lesson, but the students will learn through active involvement.

## Does performance based assessment replace college entrance exams?

No. However, a number of colleges are no longer requiring students to take entrance exams, but are requesting that students send "portfolios" (collections) of their work in a particular subject. A performance assessment would be an important part of a student's portfolio.

## What happens to the gifted and talented student?

Performance based assessment is particularly good for the gifted and talented student. Now students only demonstrate their proficiency to the limit of the traditional test. With open-ended performance based assessment, these students can truly demonstrate their gifts and talents. Thus, gifted students are identified early and given more challenging material.

**Does performance based education teach "values clarification"?**

No. What it does is require students to go beyond the memorization of facts and show how to use what they know.

**Will performance based assessment take place at every grade level?**

Yes, although often this is informal assessment by teachers. Formal assessment will probably occur at grades 4, 8, and 11. Students will also be tested in traditional ways so that their progress can be compared to national scores.

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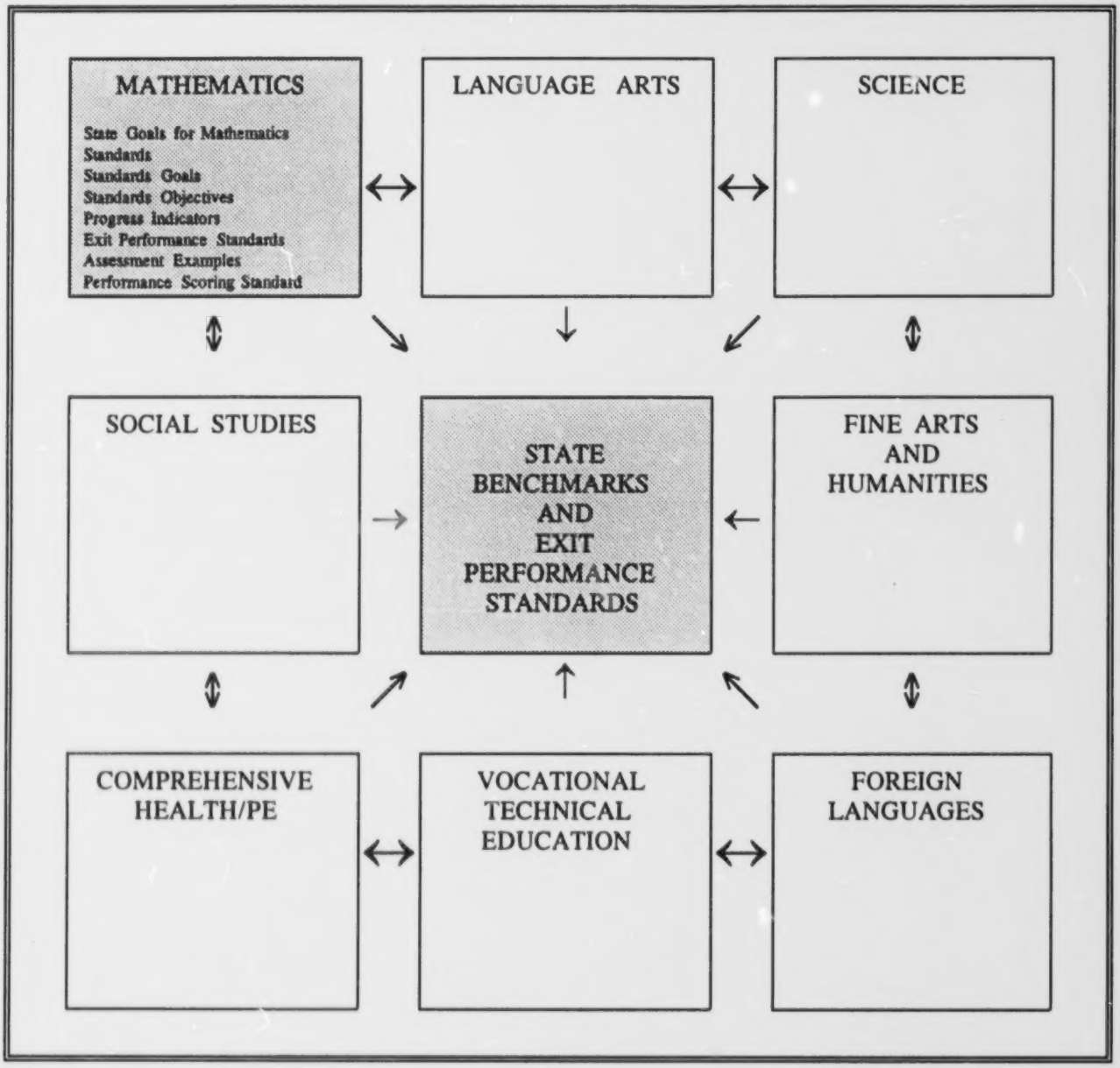
**The Idaho Performance Based Educational System is focused on Exit Performance Standards that describe what students know and can do when they graduate from high school. Benchmarks at grades 4 and 8 provide opportunities to assess students' progress toward accomplishment of the Exit Performance Standards.**

The Curricular Frameworks describe the scope and sequence of instruction and learning within each curriculum area. Working from the foundation of State Curriculum Goals and Content Standards, Grade-level Goals and Objectives have been identified. Recommended teaching and assessment practices are included.

Collectively the Curricular Frameworks address the Exit Performance Standards by encouraging the integration of student learning across the curriculum areas. The integration of learning is supported by the acquisition of knowledge and skill in each curriculum area, and it is enhanced by encouraging integrated instruction.

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CURRICULAR ALIGNMENT

## IDAHO GOALS

Broad description of what is important
in achieving proficiency in each subject area.

**EXIT PERFORMANCE**

**C U R R I C U L A R**

### STANDARDS

What high school graduates know and are able to do.

### FRAMEWORKS

A design that "Frames" a series of critical components describing what we teach and how we assess it.

## MATHEMATICS GOALS/EXIT PERFORMANCE STANDARDS MATRIX

A mathematics program designed around the subject area goals will challenge students to progress toward achievement in the Exit Performance Standards. Following is a matrix illustrating the relationship between the Idaho Goals for Mathematics and the Exit Performance Standards.

| GOALS ↓ | ↙ EXIT PERFORMANCE STANDARDS ↘ | | | | | | |
|---|---|---|---|---|---|---|---|
| | COMMUNICATE EFFECTIVELY | USE KNOWLEDGE EFFECTIVELY | SOLVES PROBLEMS EFFECTIVELY | IS CREATIVE AND ORIGINAL | DETERMINES QUALITY | COLLABORATES WITH OTHERS | IS A LIFELONG LEARNER |
| EQUAL ACCESS | X | X | X | X | X | X | X |
| CAREER AWARENESS | X | | X | | X | | X |
| VALUES MATH | X | X | | | X | X | X |
| CONFIDENT IN ABILITY | X | X | X | | X | | X |
| LEARNS TO REASON | X | X | X | | X | X | X |
| PROBLEM SOLVERS | X | | X | X | | | X |
| COMMUNICATE IN MATH | X | X | X | X | X | X | X |

An **X** in a cell indicates that specific goal addresses achievement in that specific exit performance standard.

## MISSION STATEMENT

Every student, regardless of ethnic background, gender, or ability, will start school ready to learn. Every student will be educated to the upper limits of his or her intellectual potential. All students will develop knowledge, skills, and appreciation of their responsibilities as citizens, workers, and lifelong learners.

Schools will be places where learning mathematics is exciting and challenging. Goals are clearly stated and expectations are high. Schools will be equipped with state-of-the-art technology, allowing teachers to focus on each student's needs and to serve as instructors, mentors, and motivators. Educators, parents, and communities will share responsibility for helping students prepare themselves to perform productively.

## VISION STATEMENT

The purpose of the Idaho mathematics education program is to enable learners to develop their individual potential in mathematics and to acquire the knowledge, skills and attitudes needed to contribute to a healthy society and a prosperous and sustainable economy.

All high school graduates will possess the knowledge, skills and attitudes to

* apply appropriate mathematical concepts as necessary to every day situations.
* use critical thinking and reasoning ability to solve problems.
* understand, integrate and use information and knowledge acquired from all sources.

**FURTHER:**

Through equal access to quality mathematics education, all Idaho high school graduates will understand and value lifelong learning, and possess the knowledge, skills and attitudes to:

* learn.
* use critical thinking and reasoning ability to solve problems.
* work independently and in groups.
* communicate effectively in all forms.
* understand, integrate and use information and knowledge already acquired.
* maintain personal, emotional and physical well-being.
* contribute to society as caring, responsible and thoughtful citizens.
* understand and appreciate ethnic and racial differences.

The term *all Idaho high school graduates* means students from a broad range of backgrounds and circumstances, including disadvantaged students; students with different racial and ethnic backgrounds; students with disabilities, students with limited English proficiency, and academically talented students.

## INTRODUCTION

Many of the concepts expressed in this framework are not new. However, the necessity of continually integrating these concepts, whether new or old, into the curriculum is very important. The necessity of integrating these concepts into a school's curriculum is supported by statements taken from research, numerous resources, State committees, and experiences of the committee that authored this document. With this background in mind, the Idaho K-12 framework writing committee submits the following as an Introduction.

### The Effects of Technology

Technological developments are entering our daily lives at an ever increasing degree. We casually watch the evening news as live pictures from countries thousands of miles away are beamed into our living rooms. We pick up the phone and talk to a friend in Japan as though we were calling across town. We stand in line at the supermarket chatting with the checker while each item in our shopping cart is automatically priced and listed on our receipt with one motion of the checker's hand. We give messages to answering machines, receive phone calls from computers, and get money from the bank without ever talking to another person.

When we step inside a school to see how technology is affecting the daily lives of children, we notice something interesting. While the world around them has changed dramatically, children are still tediously working on page after page of arithmetic problems, filling in the answers in the same way their grandparents did. But, while Robert is figuring out the answer to a long division problem, his grandfather is using a calculator to balance his checkbook, and the cash register is telling his sister the amount of change to give a customer. Robert's parents are studying a computer printout with the financial information they need in order to make a decision about which IRA to buy.

The contrast between Robert's school experiences and the world in which he lives is striking. **The impact of technology and its implications for mathematics education can no longer be ignored.** The modern world demands an ability to think about and to use mathematical ideas to solve problems and to make decisions. We cannot continue the rituals for producing only correct answers. Instead of requiring students to spend years studying arithmetic as a series of rules and rote procedures, it is time to provide the opportunity for **all** students to experience the richness and beauty of the study of mathematics as a whole. Students need to know how to apply those experiences and to appreciate the beauty in their everyday lives. The time our students spend learning mathematics can no longer be limited to practicing long and tedious procedures which are more efficiently done with hand held calculators or computers. Now we can, and indeed we must, enrich and strengthen the mathematics education our children receive.

### Teaching Mathematics Can Be Different

In spite of children's active interest in making sense of the world, we have in the past encountered many problems in teaching mathematics to children. Many children view mathematics as simply too hard to understand. They are often frustrated and develop feelings of math anxiety or avoidance. These problems arise, not because of the nature of mathematics itself, but because we attempt to teach

mathematics in ways that do not take into consideration what we know about how children learn. We do not give children the kind of support and mathematical tools they need to develop understanding. We continue to teach bits and pieces with the expectation that the student must put them together to form learning.

Mathematics instruction can be different. We have to provide the kinds of experiences that will allow all students to make sense of mathematics. Providing such experiences not only provides for all ability levels but will also deepen and enhance our best students' understanding.

The State Department of Education Mathematics Framework Committee organized this Mathematics Content Guide and Framework around research, the NCTM Standards, and the materials and guidance produced while moving Idaho toward a Performance Based Education system.

There are world class standards with goals and objectives that must be present to have a useful and meaningful mathematics curriculum at all levels. These are critical components, and the critical components of any curriculum or program are those *basic elements* that lie within the content of that curriculum. *The critical components should not be confused with the important basic skills of mathematics*. These are:

- Problem solving skills
- Estimation and measurement skills
- Computation skills
- Reasoning and thinking skills
- Application skills

Working within the critical components is necessary to achieving the basic skills.
The important basic skills in mathematics, which includes the exit performance standards established by the State in the State's "Performance Based" education model, must be addressed in <u>all</u> mathematics courses and/or grade levels.

The goal of the State is to have <u>all</u> students achieve in the mathematics curriculum described in this content guide and framework. A mathematics course should not fail to address the necessary basic skills or fail to move students toward achieving the exit performance standards established for mathematics education.

The guidance provided in this content guide and framework is intended to help schools develop the mathematical knowledge and skills of students such that they will demonstrate proficiency in mathematics at the grade levels or course levels indicated.

**With this introduction in mind, it is intended that the K-12 Mathematics Content Guide and Framework, outlined in this document, will serve as a model for local Idaho school districts in their mathematics curriculum, instruction, and assessment development.**

## INTRODUCTION TO K - 4 MATHEMATICS

Children in grades K - 4 are beginning to experience mathematics as a concrete operational system. Though their mathematical communication skills are developing, both in the oral and written modes, these students will need many hands-on and experiential opportunities to explore and reinforce the same mathematical concepts in various ways.

The content must be varied, including not only work with the number system but also ideas of measurement, geometry, probability and statistics, problem solving and mathematical patterns. Though learning to record the mathematical process symbolically is important, active learning using manipulatives must continue to dominate the program.

Classroom activities should stress exploration, experimentation, data gathering, comparison, and generalization. Opportunities for prediction and validation should be an integral part of the program. All activities should include opportunities for students to work cooperatively in small and large groups.

Calculators and computers should be used appropriately at all levels. These instruments can be used for concept development, exploration, or reinforcement. Calculators should be accessible to the students as an everyday tool.

Students need to identify the uses of mathematics in everyday life both in and out of the classroom. They should relate these uses to the career choices of their parents through role playing and problem solving.

## KINDERGARTEN THROUGH FOURTH GRADE MATHEMATICS

In order to help insure what should be learned at the K-4 grade levels, instructors must deal significantly with:

* Mathematics as Problem Solving
* Mathematics as Communication
* Mathematics as Reasoning
* Mathematical Connections
* Estimation
* Number Sense and Numeration
* Concepts of Whole Number Computation
* Whole number Computation
* Geometry and Spatial Sense
* Measurement
* Statistics and Probability
* Fractions and Decimals
* Patterns and Relationships

## KINDERGARTEN

STANDARD I: MATHEMATICS AS PROBLEM SOLVING

GOAL: All students will study mathematics that emphasizes problem solving.

PERFORMANCE OBJECTIVES: All students will

1. use problem-solving approaches to investigate and understand mathematical content.
2. formulate problems from everyday and mathematical situations.
3. develop and apply strategies to solve a wide variety of problems.
4. check and interpret results with respect to the original problem.
5. acquire confidence in using mathematics meaningfully.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Choose four favorite letters. Combine them in as many different ways as you can. Do any of them make a word you know? Write a sentence using your word.

STANDARD II: MATHEMATICS AS COMMUNICATION

GOAL: All students will communicate mathematically.

PERFORMANCE OBJECTIVES: All students will

1. relate physical materials, pictures, and diagrams to mathematical ideas.
2. reflect on and clarify their thinking about mathematical ideas and situations.
3. relate their everyday language to mathematical language and symbols.
4. realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Find all the mathematical concepts that can be found in a book such as Seven Blind Mice.

STANDARD III: MATHEMATICS AS REASONING

GOAL: All students will demonstrate mathematical reasoning.

PERFORMANCE OBJECTIVES: All students will

1. draw logical conclusions about mathematics.
2. use examples, known facts, properties, and relationships to explain their thinking.
3. explain their answers and solution processes.
4. recognize and use patterns to analyze mathematical situations.
5. believe that mathematics makes sense.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Sort and classify a "junk" box. Explain how to sort it, why you sorted it that way, and if there could be another way to sort it.

STANDARD IV: MATHEMATICAL CONNECTIONS

GOAL: All students will investigate mathematical connections.

PERFORMANCE OBJECTIVES: All students will

1. recognize relationships among different topics in mathematics.
2. use mathematics in other curriculum areas.
3. use mathematics in their daily lives.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Sing a number song or find a book that has numbers and counting in it. Explain how the numbers were used. Could you change that song or book by using different numbers: What would have to be different if you chose other numbers? What would stay the same?

STANDARD V: ESTIMATION

GOAL: All students will use estimation.

PERFORMANCE OBJECTIVES: All students will

1. explore estimation strategies.
2. recognize when an estimate is appropriate.
3. determine the reasonableness of results.
4. apply estimation in working with quantities, measurement, computation, and problem solving.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a referent set of ten items, determine without counting if the other sets contain more than, less than, or about the same number of objects.

STANDARD VI: NUMBER SENSE AND NUMERATION

GOAL: All students will demonstrate a developing number sense.

PERFORMANCE OBJECTIVES: All students will

1. construct number meanings through real-world experiences and the use of physical materials.

2. understand our numeration system by experiencing counting, grouping, and concepts.

3. interpret the multiple uses of numbers encountered in the real world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a pile of counters (20 or more), guess how many are in the pile? Check and see how many there are? See Standard VII for a continuation of this indicator.

STANDARD VII: CONCEPTS OF WHOLE NUMBER OPERATIONS

GOAL: All students will use the concepts of whole number operations.

PERFORMANCE OBJECTIVES: All students will

1. develop meaning for the operations by modeling and discussing a rich variety of problem situations.

2. relate mathematical language to problem situations and informal language.

3. recognize that a single operation can be represented in a wide variety of problem structures.

4. develop a sense of the meaning of operations.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. (Begun in Standard VI Sample Progress Indicator) Given a pile of counters (20 or more), guess how many are in the pile. Check and see how many there are? (Teacher adds one more to the pile and asks...) "Now, how many are there? Repeat several times.

2. (Begun in Standard VI Sample Progress Indicator) Given a pile of counters (20 or more), guess how many there are in the pile? Check and see how many there are? (Teacher takes one from the pile and asks...) "Now, how many are there? Repeat several times making sure to cross over number 20.

STANDARD VIII: WHOLE NUMBER COMPUTATION

GOAL: All students will develop underlying concepts of whole number computation.

PERFORMANCE OBJECTIVES: All students will

1. demonstrate, explain, and develop an awareness of basic facts and algorithms.

2. use a variety of mental computation and estimation techniques.

3. use calculators in appropriate situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. "Show me all the ways you can make "five (5)" using two colors of counters."

STANDARD IX: GEOMETRY AND SPATIAL SENSE

GOAL: All students will experience geometry and demonstrate a developing spatial sense.

PERFORMANCE OBJECTIVES: All students will

1. describe, model, draw, and classify shapes.

2. investigate and predict the results of combining, subdividing, and changing shapes.

3. develop spatial sense.

4. relate geometric ideas to number and measurement ideas.

5. recognize geometry in their world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Make a book of shapes including squares, triangles, circles and rectangles; such as pictures of real objects (wheel, etc.), drawings that include the shape in some way.

STANDARD X: MEASUREMENT

GOAL: All students will demonstrate a developing understanding of measurement.

PERFORMANCE OBJECTIVES: All students will

1. explore the attributes of matter such as length, capacity, weight, area, volume, time, temperature, and angle.

2. develop the process of measuring and concepts related to units of measurement.

3. make and use estimates of measurement.

4. make and use measurements in problem and everyday situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Select three (3) items; put them in order according to weight. Then check the order using a scale.

STANDARD XI: STATISTICS AND PROBABILITY

GOAL: All students will explore statistics and probability and demonstrate a developing understanding of fundamental concepts.

PERFORMANCE OBJECTIVES: All students will

1. collect, organize, and describe data.
2. construct, read, and interpret displays of data.
3. formulate and solve problems that involve collecting and analyzing data.
4. explore concepts of chance.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a collection of cubes in two colors, grab three handsful of cubes. Arrange the cubes on graph paper and describe the results in a variety of ways.

STANDARD XII: FRACTIONS AND DECIMALS

GOAL: All students will demonstrate a developing understanding of fractions and decimals.

PERFORMANCE OBJECTIVES: All students will

1. develop an awareness of the concepts of fractions, mixed number, and decimals.
2. develop number sense for fractions and decimals.
3. use examples to explore operations on fractions and decimals.
4. apply fractions and decimals to problem situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a collection of twenty, divide the group in half. Then divide each half again and describe the results.

STANDARD XIII: PATTERNS AND RELATIONSHIPS

GOAL: All students will demonstrate an understanding of patterns and relationships.

PERFORMANCE OBJECTIVES: All students will

1. recognize, describe, extend, and create a wide variety of patterns.
2. demonstrate and describe mathematical relationships.
3. explore the use of variables and open sentences to express relationships.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a set of objects, extend a given pattern.

## FIRST GRADE

STANDARD I: MATHEMATICS AS PROBLEM SOLVING

GOAL: All students will study mathematics that emphasizes problem solving.

PERFORMANCE OBJECTIVES: All students will

1. use problem-solving approaches to investigate and understand mathematical content.
2. formulate problems from everyday and mathematical situations.
3. develop and apply strategies to solve a wide variety of problems.
4. check and interpret results with respect to the original problem.
5. acquire confidence in using mathematics meaningfully.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Choose a number. Show several ways of getting that number.

STANDARD II: MATHEMATICS AS COMMUNICATION

GOAL: All students will communicate mathematically.

PERFORMANCE OBJECTIVES: All students will

1. relate physical materials, pictures, and diagrams to mathematical ideas.
2. reflect on and clarify their thinking about mathematical ideas and situations.
3. relate their everyday language to mathematical language and symbols.
4. realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Sort attribute blocks in a number of different ways. Explain the sorting rule.

2. Create a picture with one shape or a combination of shapes.

STANDARD III: MATHEMATICS AS REASONING

GOAL: All students will demonstrate mathematical reasoning.

PERFORMANCE OBJECTIVES: All students will

1. draw logical conclusions about mathematics.

2. use examples, known facts, properties, and relationships to explain their thinking.

3. explain their answers and solution processes.

4. recognize and use patterns to analyze mathematical situations.

5. believe that mathematics makes sense.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Choose a strategy to solve this problem. Two numbers make ten (10). If one number increases, what happens to the other number? Show your method of doing this problem.

STANDARD IV: MATHEMATICAL CONNECTIONS

GOAL: All students will investigate mathematical connections.

PERFORMANCE OBJECTIVES: All students will

1. recognize relationships among different topics in mathematics.
2. use mathematics in other curriculum areas.
3. use mathematics in their daily lives.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Read books about pairs or twos or halves. Create a bulletin board (or a page for a book) of pairs.
2. Plan a half birthday party where all the gifts are halves.

STANDARD V: ESTIMATION

GOAL: All students will use estimation.

PERFORMANCE OBJECTIVES: All students will

1. explore estimation strategies.
2. recognize when an estimate is appropriate.
3. determine the reasonableness of results.
4. apply estimation in working with quantities, measurement, computation, and problem solving.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a box that will hold fewer than one hundred (100) cubes. Estimate the number of cubes that will fill the box.

STANDARD VI: NUMBER SENSE AND NUMERATION

GOAL: All students will demonstrate a developing number sense.

PERFORMANCE OBJECTIVES: All students will

1. construct number meanings through real-world experiences and the use of physical materials.

2. understand our numeration system by experiencing counting, grouping, and concepts.

3. interpret the multiple uses of numbers encountered in the real world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a two digit number, build it using manipulatives demonstrating place value understanding.

2. Write the counting numbers to 30. Explain how to continue the sequence.

## STANDARD VII: CONCEPTS OF WHOLE NUMBER OPERATIONS

GOAL: All students will use the concepts of whole number operations.

PERFORMANCE OBJECTIVES: All students will

1. develop meaning for the operations by modeling and discussing a rich variety of problem situations.

2. relate mathematical language to problem situations and informal language.

3. recognize that a single operation can be represented in a wide variety of problem structures.

4. develop a sense of the meaning of operations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a set of six (6) objects. With the teacher hiding some of them, determine the number hidden while looking at those remaining.

## STANDARD VIII: WHOLE NUMBER COMPUTATION

GOAL: All students will develop underlying concepts of whole number computation.

PERFORMANCE OBJECTIVES: All students will

1. demonstrate, explain, and develop an awareness of basic facts and algorithms.
2. use a variety of mental computation and estimation techniques.
3. use calculators in appropriate situations.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given two (2) colors of counters, build as many different combinations of twenty (20) as possible record the numbers representing these combinations.
2. Given two (2) stacks of ten (10), break off and record a variety of subtraction problems.

## STANDARD IX: GEOMETRY AND SPATIAL SENSE

GOAL: All students will experience geometry and demonstrate a developing spatial sense.

PERFORMANCE OBJECTIVES: All students will

1. describe, model, draw, and classify shapes.
2. investigate and predict the results of combining, subdividing, and changing shapes.
3. develop spatial sense.
4. relate geometric ideas to number and measurement ideas.
5. recognize geometry in their world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a "feely" box, describe a geometric solid using at least three different characteristics such as: number of sides, faces, vertices, etc.

STANDARD X: MEASUREMENT

GOAL: All students will demonstrate a developing understanding of measurement.

PERFORMANCE OBJECTIVES: All students will

1. explore the attributes of matter such as length, capacity, weight, area, volume, time, temperature, and angle.

2. develop the process of measuring and concepts related to units of measurement.

3. make and use estimates of measurement.

4. make and use measurements in problem and everyday situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a stick of ten (10) interlocking cubes, estimate and then measure the height or length of five (5) objects.

STANDARD XI: STATISTICS AND PROBABILITY

GOAL: All students will explore statistics and probability and demonstrate a developing understanding of fundamental concepts.

PERFORMANCE OBJECTIVES: All students will

1. collect, organize, and describe data.

2. construct, read, and interpret displays of data.

3. formulate and solve problems that involve collecting and analyzing data.

4. explore concepts of chance.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given five (5) two-color counters in a cup, students will shake and spill the contents ten (10) times. Students will devise a system to record the results after each turn. They will describe their results.

STANDARD XII: FRACTIONS AND DECIMALS

GOAL: All students will demonstrate a developing understanding of fractions and decimals.

PERFORMANCE OBJECTIVES: All students will

1. develop and awareness of the concepts of fractions, mixed number, and decimals.

2. develop number sense for fractions and decimals.

3. use examples to explore operations on fractions and decimals.

4. apply fractions and decimals to problem situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given 8 1/2 X 11 sheets of paper, students will fold one sheet to show halves, one to show fourths, and one to show eighths. They will identify one half, one fourth, and one eighth.

## STANDARD XIII: PATTERNS AND RELATIONSHIPS

GOAL: All students will demonstrate an understanding of patterns and relationships.

PERFORMANCE OBJECTIVES: All students will

1. recognize, describe, extend, and create a wide variety of patterns.
2. demonstrate and describe mathematical relationships.
3. explore the use of variables and open sentences to express relationships.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Select objects and make three different patterns that repeat at least 2 1/2 times.

## SECOND GRADE

STANDARD I: MATHEMATICS AS PROBLEM SOLVING

GOAL: All students will study mathematics that emphasizes problem solving.

PERFORMANCE OBJECTIVES: All students will

1. use problem-solving approaches to investigate and understand mathematical content.
2. formulate problems from everyday and mathematical situations.
3. develop and apply strategies to solve a wide variety of problems.
4. check and interpret results with respect to the original problem.
5. acquire confidence in using mathematics meaningfully.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Using geoboards, make as many different triangles as possible. Use geoboard recording paper and show each one.

STANDARD II: MATHEMATICS AS COMMUNICATION

GOAL: All students will communicate mathematically.

PERFORMANCE OBJECTIVES: All students will

1. relate physical materials, pictures, and diagrams to mathematical ideas.
2. reflect on and clarify their thinking about mathematical ideas and situations.
3. relate their everyday language to mathematical language and symbols.
4. realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Listen to a story about giants. Generate a list of all the changes needed if a giant came to live in the town.

STANDARD III: MATHEMATICS AS REASONING

GOAL: All students will demonstrate mathematical reasoning.

PERFORMANCE OBJECTIVES: All students will

1. draw logical conclusions about mathematics.
2. use examples, known facts, properties, and relationships to explain their thinking.
3. explain their answers and solution processes.
4. recognize and use patterns to analyze mathematical situations.
5. believe that mathematics makes sense.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Use this problem as an example. "I am an odd number. I am more than 21 and less than 31. I am not 25. The sum of my digits is eleven (11). Who am I?" Make up three (3) "Who Am I" problems. Try a rule to explain how this was done.

STANDARD IV: MATHEMATICAL CONNECTIONS

GOAL: All students will investigate mathematical connections.

PERFORMANCE OBJECTIVES: All students will

1. recognize relationships among different topics in mathematics.
2. use mathematics in other curriculum areas.
3. use mathematics in their daily lives.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. In a newspaper, find twelve (12) examples of using mathematics.

STANDARD V: ESTIMATION

GOAL: All students will use estimation.

PERFORMANCE OBJECTIVES: All students will

1. explore estimation strategies.
2. recognize when an estimate is appropriate.
3. determine the reasonableness of results.
4. apply estimation in working with quantities, measurement, computation, and problem solving.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Describe a situation that would require the use of estimation.

STANDARD VI: NUMBER SENSE AND NUMERATION

GOAL: All students will demonstrate a developing number sense.

PERFORMANCE OBJECTIVES: All students will

1. construct number meanings through real-world experiences and the use of physical materials.
2. understand our numeration system by experiencing counting, grouping, and concepts.
3. interpret the multiple uses of numbers encountered in the real world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given any three-digit number, represent it using base ten (10) blocks or other appropriate manipulatives.

STANDARD VII: CONCEPTS OF WHOLE NUMBER OPERATIONS

GOAL: All students will use the concepts of whole number operations.

PERFORMANCE OBJECTIVES: All students will

1. develop meaning for the operations by modeling and discussing a rich variety of problem situations.

2. relate mathematical language to problem situations and informal language.

3. recognize that a single operation can be represented in a wide variety of problem structures.

4. develop a sense of the meaning of operations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Make up a problem using two-digit addition and/or subtraction (include regrouping). Show it with manipulatives and symbolically.

STANDARD VIII: WHOLE NUMBER COMPUTATION

GOAL: All students will develop underlying concepts of whole number computation.

PERFORMANCE OBJECTIVES: All students will

1. demonstrate, explain, and develop an awareness of basic facts and algorithms.

2. use a variety of mental computation and estimation techniques.

3. use calculators in appropriate situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Make up three two-digit addition and three two-digit subtraction problems. Estimate answers. Demonstrate solving the problem using manipulatives. Record the process and include the algorithm. Check it on the calculator.

STANDARD IX: GEOMETRY AND SPATIAL SENSE

GOAL: All students will experience geometry and demonstrate a developing spatial sense.

PERFORMANCE OBJECTIVES: All students will

1. describe, model, draw, and classify shapes.
2. investigate and predict the results of combining, subdividing, and changing shapes.
3. develop spatial sense.
4. relate geometric ideas to number and measurement ideas.
5. recognize geometry in their world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Describe the relationships between the pattern block pieces. Write sentences about what was discovered.

STANDARD X: MEASUREMENT

GOAL: All students will demonstrate a developing understanding of measurement.

PERFORMANCE OBJECTIVES: All students will

1. explore the attributes of matter such as length, capacity, weight, area, volume, time, temperature, and angle.

2. develop measuring skills and concepts related to units of measurement.

3. make and use estimates of measurement.

4. make and use measurements in problem and everyday situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Design a bed for a favorite stuffed animal, make a drawing and label it with measurements.

## STANDARD XI: STATISTICS AND PROBABILITY

GOAL: All students will explore statistics and probability and demonstrate a developing understanding of fundamental concepts.

PERFORMANCE OBJECTIVES: All students will

1. collect, organize, and describe data.

2. construct, read, and interpret displays of data.

3. formulate and solve problems involving collecting and analyzing data.

4. explore concepts of chance.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. From a bag of ten (10) objects of two different colors, choose one, record the color and replace it in the bag. Repeat the process ten (10) times and record the results on each try. After ten (10) times, the student will predict the number of each color of cube.

## STANDARD XII: FRACTIONS AND DECIMALS

GOAL: All students will demonstrate a developing understanding of fractions and decimals.

PERFORMANCE OBJECTIVES: All students will

1. develop and awareness of the concepts of fractions, mixed number, and decimals.
2. develop number sense for fractions and decimals.
3. use examples to explore operations on fractions and decimals.
4. apply fractions and decimals to problem situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a box of pennies, nickels, dimes, and quarters, students will demonstrate all the ways they can make a collection equal to a dime and a quarter.

## STANDARD XIII: PATTERNS AND RELATIONSHIPS

GOAL: All students will demonstrate an understanding of patterns and relationships.

PERFORMANCE OBJECTIVES: All students will

1. recognize, describe, extend, and create a wide variety of patterns.
2. demonstrate and describe mathematical relationships.
3. explore the use of variables and open sentences to express relationships.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Select four (4) objects and create a pattern that is twenty (20) objects long. Repeat it 2 1/2 times. Rename it in at least three (3) different ways. (Such as letters, numbers, pictures, sounds, body movements, etc.)

## THIRD GRADE

STANDARD I: MATHEMATICS AS PROBLEM SOLVING

GOAL: All students will study mathematics that emphasizes problem solving.

PERFORMANCE OBJECTIVES: All students will

1. use problem-solving approaches to investigate and understand mathematical content.
2. formulate problems from everyday and mathematical situations.
3. develop and apply strategies to solve a wide variety of problems.
4. check and interpret results with respect to the original problem.
5. acquire confidence in using mathematics meaningfully.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The day is composed of 24 hours. Divide the day into equal parts in at least two (2) ways. Draw pictures to represent activities that might be part of each time. Write five (5) math sentences about the results.

STANDARD II: MATHEMATICS AS COMMUNICATION

GOAL: All students will communicate mathematically.

PERFORMANCE OBJECTIVES: All students will

1. relate physical materials, pictures, and diagrams to mathematical ideas.
2. reflect on and clarify their thinking about mathematical ideas and situations.
3. relate their everyday language to mathematical language and symbols.
4. realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Make a scale drawing of your bedroom.

STANDARD III: MATHEMATICS AS REASONING

GOAL: All students will demonstrate mathematical reasoning.

PERFORMANCE OBJECTIVES: All students will

1. draw logical conclusions about mathematics.
2. use examples, known facts, properties, and relationships to explain their thinking.
3. explain their answers and solution processes.
4. recognize and use patterns to analyze mathematical situations.
5. believe that mathematics makes sense.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Explain what place value means. Use diagrams, pictures, or manipulatives, as needed.

STANDARD IV: MATHEMATICAL CONNECTIONS

GOAL: All students will investigate mathematical connections.

PERFORMANCE OBJECTIVES: All students will

1. recognize relationships among different topics in mathematics.
2. use mathematics in other curriculum areas.
3. use mathematics in their daily lives.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Choose someone to interview. Predict how that person uses mathematics in their work. Interview them to confirm the prediction. Prepare a report and present the findings to the class.

STANDARD V: ESTIMATION

GOAL: All students will use estimation.

PERFORMANCE OBJECTIVES: All students will

1. explore estimation strategies.
2. recognize when an estimate is appropriate.
3. determine the reasonableness of results.
4. apply estimation in working with quantities, measurement, computation, and problem solving.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given $10.00 would it be possible to buy a soccer ball, a refrigerator, or a bicycle? Explain your answer orally or in writing.

STANDARD VI: NUMBER SENSE AND NUMERATION

GOAL: All students will demonstrate a developing number sense.

PERFORMANCE OBJECTIVES: All students will

1. construct number meanings through real-world experiences and the use of physical materials.
2. understand our numeration system by experiencing counting, grouping, and concepts.
3. interpret the multiple uses of numbers encountered in the real world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Generate a list of real-life situations that might use a four-digit number.

STANDARD VII: CONCEPTS OF WHOLE NUMBER OPERATIONS

GOAL: All students will use the concepts of whole number operations.

PERFORMANCE OBJECTIVES: All students will

1. develop meaning for the operations by modeling and discussing a rich variety of problem situations.

2. relate mathematical language to problem situations and informal language.

3. recognize that a single operation can be represented in a wide variety of problem structures.

4. develop a sense of the meaning of operations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given $100.00 in MONOPOLY MONEY, purchase groups of items. Show the entire process in words, numbers and pictures.

STANDARD VIII: WHOLE NUMBER COMPUTATION

GOAL: All students will develop underlying concepts of whole number computation.

PERFORMANCE OBJECTIVES: All students will

1. demonstrate, explain, and develop an awareness of basic facts and algorithms.

2. use a variety of mental computation and estimation techniques.

3. use calculators in appropriate situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Divide nine (9) straws equally among four people. How many pieces does each student get, if the straws may be cut? How can this number be written? Is the answer the same if nine (9) pencils are divided among four children? Explain your answer.

STANDARD IX: GEOMETRY AND SPATIAL SENSE

GOAL: All students will experience geometry and demonstrate a developing spatial sense.

PERFORMANCE OBJECTIVES: All students will

1. describe, model, draw, and classify shapes.
2. investigate and predict the results of combining, subdividing, and changing shapes.
3. develop spatial sense.
4. relate geometric ideas to number and measurement ideas.
5. recognize geometry in their world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given the rules for pentominoes and one inch graph paper discover and construct twelve (12) shapes.

STANDARD X: MEASUREMENT

GOAL: All students will demonstrate a developing understanding of measurement.

PERFORMANCE OBJECTIVES: All students will

1. explore the attributes of matter such as length, capacity, weight, area, volume, time, temperature, and angle.

2. develop the process of measuring and concepts related to units of measurement.

3. make and use estimates of measurement.

4. make and use measurements in problem and everyday situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Identify five (5) situations where measuring is necessary. What units of measurement are most appropriate? Which tools can you use?

STANDARD XI: STATISTICS AND PROBABILITY

GOAL: All students will explore statistics and probability and demonstrate a developing understanding of fundamental concepts.

PERFORMANCE OBJECTIVES: All students will

1. collect, organize, and describe data.

2. construct, read, and interpret displays of data.

3. formulate and solve problems that involve collecting and analyzing data.

4. explore concepts of chance.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Think of a category of favorite toys, games, etc. Interview ten (10) classmates; record the results. Design a graph to display the results. Explain the results.

STANDARD XII: FRACTIONS AND DECIMALS

GOAL: All students will demonstrate a developing understanding of fractions and decimals.

PERFORMANCE OBJECTIVES: All students will

1. develop and awareness of the concepts of fractions, mixed number, and decimals.

2. develop number sense for fractions and decimals.

3. use examples to explore operations on fractions and decimals.

4. apply fractions and decimals to problem situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Plan a party. Make up five (5) problems that must be answered by using fractions or decimals.

STANDARD XIII: PATTERNS AND RELATIONSHIPS

GOAL: All students will demonstrate an understanding of patterns and relationships.

PERFORMANCE OBJECTIVES: All students will

1. recognize, describe, extend, and create a wide variety of patterns.

2. demonstrate and describe mathematical relationships.

3. explore the use of variables and open sentences to express relationships.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Create a 100's chart. Using a variety of colors, color in patterns on the chart. Record the patterns created. Explain the rule for the patterns created.

## FOURTH GRADE

STANDARD I: MATHEMATICS AS PROBLEM SOLVING

GOAL: All students will study mathematics that emphasizes problem solving.

PERFORMANCE OBJECTIVES: All students will

1. use problem-solving approaches to investigate and understand mathematical content.
2. formulate problems from everyday and mathematical situations.
3. develop and apply strategies to solve a wide variety of problems.
4. check and interpret results with respect to the original problem.
5. acquire confidence in using mathematics meaningfully.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given pennies, nickels, and dimes in a bowl. If the teacher puts three (3) coins in one hand, make a chart of the possibilities.

STANDARD II: MATHEMATICS AS COMMUNICATION

GOAL: All students will communicate mathematically.

PERFORMANCE OBJECTIVES: All students will

1. relate physical materials, pictures, and diagrams to mathematical ideas.
2. reflect on and clarify their thinking about mathematical ideas and situations.
3. relate their everyday language to mathematical language and symbols.
4. realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Draw a map of the route from home to school. Give written directions.

STANDARD III: MATHEMATICS AS REASONING

GOAL: All students will demonstrate mathematical reasoning.

PERFORMANCE OBJECTIVES: All students will

1. draw logical conclusions about mathematics.
2. use examples, known facts, properties, and relationships to explain their thinking.
3. explain their answers and solution processes.
4. recognize and use patterns to analyze mathematical situations.
5. believe that mathematics makes sense.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. We have a rule in our class. If it is raining we stay inside. If it is not raining we go outside. We have another rule. If we have just returned from being sick, we stay inside. Today, I stayed inside. So is it raining? Explain your answer. Make up a similar problem.

STANDARD IV: MATHEMATICAL CONNECTIONS

GOAL: All students will investigate mathematical connections.

PERFORMANCE OBJECTIVES: All students will

1. recognize relationships among different topics in mathematics.
2. use mathematics in other curriculum areas.
3. use mathematics in their daily lives.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Select a job description with salary from the want ads. Also select a hypothetical family and describe it. Complete the tax form EZ 1040A for that family.

STANDARD V: ESTIMATION

GOAL: All students will use estimation.

PERFORMANCE OBJECTIVES: All students will

1. explore estimation strategies.
2. recognize when an estimate is appropriate.
3. determine the reasonableness of results.
4. apply estimation in working with quantities, measurement, computation, and problem solving.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. List five situations when it would be more appropriate to estimate than to give an exact answer.

STANDARD VI: NUMBER SENSE AND NUMERATION

GOAL: All students will demonstrate a developing number sense.

PERFORMANCE OBJECTIVES: All students will

1. construct number meanings through real-world experiences and the use of physical materials.
2. understand our numeration system by experiencing counting, grouping, and concepts.
3. interpret the multiple uses of numbers encountered in the real world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. On a piece of graph paper, show 36 in a variety of ways, with none of the combinations being less than two (2). Write the algorithm shown.

STANDARD VII: CONCEPTS OF WHOLE NUMBER OPERATIONS

GOAL: All students will use the concepts of whole number operations.

PERFORMANCE OBJECTIVES: All students will

1. develop meaning for the operations by modeling and discussing a rich variety of problem situations.

2. relate mathematical language to problem situations and informal language.

3. recognize that a single operation can be represented in a wide variety of problem structures.

4. develop a sense of the meaning of operations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The class is given $100.00 to plan a spring party. There are three committees: decorations, food, and entertainment. Determine how much each group will need and divide the money. Record the process in a report.

STANDARD VIII: WHOLE NUMBER COMPUTATION

GOAL: All students will develop underlying concepts of whole number computation.

PERFORMANCE OBJECTIVES: All students will

1. demonstrate, explain, and develop an awareness of basic facts and algorithms.

2. use a variety of mental computation and estimation techniques.

3. use calculators in appropriate situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Generate a list of similar items and prices from two (2) different stores. Determine what should be purchased from each store. Explain your answer.

## STANDARD IX: GEOMETRY AND SPATIAL SENSE

GOAL: All students will experience geometry and demonstrate a developing spatial sense.

PERFORMANCE OBJECTIVES: All students will

1. describe, model, draw, and classify shapes.

2. investigate and predict the results of combining, subdividing, and changing shapes.

3. develop spatial sense.

4. relate geometric ideas to number and measurement ideas.

5. recognize geometry in their world.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a pattern, cut out a tangram. Describe the relationships between the pieces. Reconstruct the square.

STANDARD X: MEASUREMENT

GOAL: All students will demonstrate a developing understanding of measurement.

PERFORMANCE OBJECTIVES: All students will

1. explore the attributes of matter such as length, capacity, weight, area, volume, time, temperature, and angle.

2. develop the process of measuring and concepts related to units of measurement.

3. make and use estimates of measurement.

4. make and use measurements in problem and everyday situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given a box of cereal, describe as many ways as possible to measure the box and the contents using five (5) of the following attributes: weight, volume, height, number of cereal units, perimeter, area of box face or total surface area, price, etc.

STANDARD XI: STATISTICS AND PROBABILITY

GOAL: All students will explore statistics and probability and demonstrate a developing understanding of fundamental concepts.

PERFORMANCE OBJECTIVES: All students will

1. collect, organize, and describe data.

2. construct, read, and interpret displays of data.

3. formulate and solve problems that involve collecting and analyzing data.

4. explore concepts of chance.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Using a spinner with a circle divided 1/4 yellow, 1/4 blue, and 1/2 red. Predict how many times the spinner will land on each color in twenty (20) tries. Spin, record the results, and compare these numbers with the predictions. Explain the results. Explain how to change the circle to obtain different results (such as more chances of landing on blue).

STANDARD XII: FRACTIONS AND DECIMALS

GOAL: All students will demonstrate a developing understanding of fractions and decimals.

PERFORMANCE OBJECTIVES: All students will

1. develop and awareness of the concepts of fractions, mixed number, and decimals.

2. develop number sense for fractions and decimals.

3. use examples to explore operations on fractions and decimals.

4. apply fractions and decimals to problem situations.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Given one hundred square grids, color in a given region such as: 3/4, 2/5, 1/25, .3, .45, .7. Label the region with the common or decimal fraction and put them in order.

STANDARD XIII: PATTERNS AND RELATIONSHIPS

GOAL: All students will demonstrate an understanding of patterns and relationships.

PERFORMANCE OBJECTIVES: All students will

1. recognize, describe, extend, and create a wide variety of patterns.

2. demonstrate and describe mathematical relationships.

3. explore the use of variables and open sentences to express relationships.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Create a surrounding pattern. Write directions to recreate this pattern. Test them on another student.

## IDAHO 4TH GRADE BENCHMARKS

The Idaho 4th grade benchmarks require mastery of basic skills and subject knowledge. Students' proficiency in these benchmarks will be measured through a variety of tasks included in the Statewide Testing Program.

**An Idaho 4th Grader**

- **communicates effectively.**
- **uses knowledge, information, and technology effectively.**
- **solves problems.**
- **is creative and original.**
- **collaborates with others.**
- **determines quality.**
- **is a lifelong learner.**

What follows is a more complete statement of each benchmark and a list of traits which describe each benchmark in more detail.

1. **An Idaho 4th grader communicates effectively in written, oral and multimedia forms (such as audio and video recorded presentations; charts, graphs and visual aids; and computer enhanced presentations).**

   LIST OF TRAITS

   - Ideas and Content -- The communication is clear, focused, interesting, and appropriate for the audience. Details and anecdotes demonstrate a command of the subject.
   - Organization -- Communication is organized, and flows sequentially. The order, structure, and presentation are well organized and address issues in a clear and direct manner.
   - Voice -- The communication speaks appropriately and directly to the audience in a way that is individualistic, expressive and engaging.

- Form -- The communication conveys the intended message in an interesting, precise, and natural way. Words, and visual aids are used appropriately to enhance the presentation.

- Fluency -- The elements of spoken communication (including pronunciation, enunciation, inflection, and projection) are developing.

- Conventions -- Written communication involves grammar, capitalization, punctuation, usage, spelling and paragraphing that enhances the overall quality of the communication. Errors tend to be few and minor so that the communication is not interrupted.

2. **An Idaho 4th grader locates, organizes and uses knowledge, information, and technology effectively.**

LIST OF TRAITS

- Reading -- Written information is read with accuracy and understanding.

- Active Listening -- Verbal information is understood by the listener and evaluated for consistency and new understanding. Appropriate feedback is given to the speaker via summary comments and appropriate questioning.

- Identification of Sources -- Sources of knowledge and information are identified and used efficiently. Information technology is used appropriately.

- Organization of Information -- Information and knowledge are employed. Clear criteria are employed to select relevant and accurate information and knowledge for presentation and use. Information is effectively organized using clear criteria to select materials.

3. **An Idaho 4th grader can identify and describe problems or issues and develops effective strategies for addressing those concerns.**

LIST OF TRAITS

- Presentation of Components -- The issue is clearly described, using figures, diagrams, or models as appropriate.

- Development and Implementation Strategies -- Alternative strategies for solving or addressing problems, issues or projects are identified.

- Verification of Results -- Results are related to prior knowledge and evaluated for reasonableness.

4. **An Idaho 4th grader demonstrates creativity and originality in the design, production, and presentation of activities.**

   LIST OF TRAITS

   - Creativity and Originality -- Innovative methods of design, production, and presentation are explored.

5. **An Idaho 4th grader critiques and evaluates the quality of work products and process.**

   LIST OF TRAITS

   - Group and Self-evaluation -- Individuals and groups are able to critique their own work and the work of others.
   - Identification of Strengths -- Evidence of ability, talent, and knowledge are identified within the performance and related to previous performances.
   - Identification of Weaknesses -- Areas for further improvement are identified and ideas for improvement are discussed.

6. **An Idaho 4th grader demonstrates the ability and skills to work collaboratively.**

   LIST OF TRAITS

   - Behavior -- Personal behavior in group activities is monitored and consideration for individual differences is demonstrated.
   - Team Skills -- Active listening and participation skills are used in group activities.
   - Provide Feedback -- Constructive comments on cooperative work are given and received.
   - Group Functioning -- How the group does its work is assessed and managed. Conflict resolution skills are used to solve group problems.
   - Ethnic and Racial Differences -- Learn to live in a changing society with mutual respect and appreciation for others.

7. **An Idaho 4th grader demonstrates characteristics of an effective lifelong learner.**

LIST OF TRAITS

- Vision -- Priorities and attainable goals are identified.
- Self-esteem -- A positive vision for self and others is developed. There is a positive desire to learn.
- Initiative and Perseverance -- The desire and ability to plan and implement project activity over time and to work through to the conclusion of the project is demonstrated.
- Responsibility -- Responsibility for own actions is assumed.
- Adaptability -- Changes and challenges encountered are dealt with in a positive way.
- Skills of Strategic Learner -- A variety of strategies for learning are explored.

Following are example **4th Grade Performance Assessment** items.

1. How many numbers are there between 4 and 6?

    a. Describe in writing the different kinds of numbers between 4 and 6.
    b. List the numbers.
    c. Describe in writing how you know the numbers you find are between two given numbers.

2. Order these seven terms from most general to most specific. Polygon, rectangle, square, quadrilateral, trapezoid, parallelogram, and figure.

    a. Describe in writing each figure.
    b. Describe in writing how well you think you solved this problem.

3. The temperature was 22 degrees just 8 hours ago. Now it is 4 degrees below zero. How many degrees has the temperature changed?

    a. Has the temperature changed to warmer or colder? Explain.
    b. Draw a figure illustrating your solution.
    c. Describe how you arrive at the answers in "a" and "b."

4. Following is the cost of several items:

    A candy bar costs 50¢; a piece of bubble gum costs 5¢; a bag of M & Ms costs 75¢; one hard candy costs 2¢; one licorice costs 10¢; a ruler costs 15¢;an eraser costs 10¢; and a pen costs 45¢.

    You buy 3 items. You give the store clerk 7 dimes, and you get 3¢ change.

    a. What all could have you bought?
    b. Describe why you could have purchased several different groups of 3 items.
    c. Describe in writing how well you think you solved this problem.

5. You, your sister, your dad, and your mother are going for a ride in the car. There will be two of you in the front seat and two of you in the back seat. If your mother drives, what are all the ways you and your family can be seated in the car?

    a. Describe in writing a way to solve this problem.
    b. How many possible arrangements for seating are there?
    c. Describe in writing how well you think you solved this problem.

[ ] Yes, I used a calculator with this problem; [ ] No, I did not use a calculator is a question asked at the end of each problem.

**IDAHO PERFORMANCE MATHEMATICS ASSESSMENT SCORING STANDARD**
**Shaded Areas Identify Other Suggested Performances Classroom Teachers Might Consider**

A score of '4' indicates that the student has advanced understanding of the situation given. The student recognizes the problem that is presented and internalizes it and decides what process would be best to solve the problem. The student demonstrates the higher order thinking skills that brings the process of determining a solution a step above the norm. The student then carries out the processes and is able to communicate them well on paper.

4 -- ADVANCED PROFICIENCY AT GRADE LEVEL

* Demonstrates advanced proficiency in basic skills
* Advanced understanding of situation
* Advanced communication skills in the subject area
* Demonstrates higher order thinking skills (synthesis, analysis, evaluation)
* Process is clear and appropriate
* Uses problem solving strategies effectively
* Errors are minimal or non-existent
* Solutions are correct
* Student is innovative and creative
* Works well with others when and where applicable
* Participates voluntarily in class activities when appropriate
* Able to evaluate self and adjust
* Appears willing to work equally or beyond expectations
* Takes advantage of the tools instrumental in "DOING" the work necessary to succeed



A score of '3' indicates that the student has an understanding of the situation given. The responses demonstrate a higher order level of thinking but not an advanced level. Problem solving strategies are shown correctly but there may be some surface errors that does not factor into correct solutions. Structure is well defined and adaptable. Demonstrated performance is proficient at grade level.

3 -- PROFICIENT AT GRADE LEVEL

* Demonstrates proficiency in basic skills
* Demonstrates understanding of situation
* Demonstrates effective communication skills in the subject area
* Uses higher order thinking skills (synthesis, analysis, evaluation)
* Process is adaptable
* Problem solving strategies are evident
* Some surface errors
* Solutions are defendable
* Well defined structured process
* Generally works well with others
* Participates in activities
* Demonstrates an ability to usually evaluate self
* Uses the appropriate mathematics tools effectively

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A score of '2' indicates that the student is on the way to developing proficiency in mathematics. There is limited evidence that the student understands a given situation. The student has difficulty in communicating information about the problem. Basic thinking skills and purpose are apparent but problem solving strategies and process development are limited. Frequent surface errors and lack of structure detract from proficient performance.

2 -- DEVELOPING TOWARD GRADE LEVEL PROFICIENCY

* Demonstrates developing proficiency in basic skills
* Limited evidence of understanding of situation
* Evidence of limited communication skills in subject area
* Demonstrates basic use of thinking skills
* Purpose may be evident but lacks development of process
* Limited use of problem solving strategies
* Frequent surface errors
* Seldom able to defend solutions
* Lacks structure
* Has difficulty working with others
* Poor participation in activities
* Does not always complete assigned work

A score of '1' indicates that the student is having difficulty with basic mathematics and implementing mathematical problem solving strategies. There is usually an attempt at solving the problem but basic thinking skill, structure, and process development is severely lacking. There are frequent errors, and the lack of communication skill is evident. Development toward proficiency at grade level is not evident.

1 -- MINIMUM DEVELOPMENT TOWARD PROFICIENCY AT GRADE LEVEL

* Demonstrates minimal development in basic skills
* Minimal evidence of understanding of situation
* Evidence of poor communication skills in subject area
* Demonstrates minimal use of basic thinking skills
* Lacks process development
* Minimal evidence of problem solving strategies
* Errors are common
* Incorrect solutions
* Minimal evidence of organization
* Ill-defined process
* Demonstrates a lack of ability to work with others
* Lacks motivation to participate in activities
* Shows evidence of not willing to do work

==========

NS -- NOT SCORABLE

* Blank
* Illegible





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## INTRODUCTION TO 5 - 8 MATHEMATICS

Students in grades 5-8 are beginning to use abstract reasoning, but still need much practice with concrete materials. They need active learning strategies with manipulatives whenever possible, video, auditory or tactile experiences and real-world applications.

The content will include a broad range of topics, including algebra, functions, statistics, and probability. However, although each area is important, the topics should be taught as an integrated whole, rather than isolated entities. Mathematics should also be connected with all other content areas, providing students with clear understanding of the applications for their learning.

Classroom activities should include opportunities for students to work individually and in small and large cooperative groups. The arrangement should be determined by the instructional goals as well as the nature of the activity. These cooperative activities support the goals of increasing mathematics communication skills and connections.

The use of technology, including calculators, computers, and videos, is common place in our society. As computation becomes less important, the skills and understandings required to make proficient use of technology become more important. Students and teachers need to know how to choose the appropriate technology to solve problems. Technology needs to be integrated into the curriculum as the "paper and pencil" tools of the 21st century.

Students need to understand and identify how mathematics is used in various career areas. This can be done through career exploration activities, including role playing, problem solving, and research.

## 5 - 8 MATHEMATICS

In order to help insure what should be learned at the 5 - 8 grade levels, instructors must deal significantly with:

* Mathematics as Problem Solving
* Mathematics as Communication
* Mathematics as Reasoning
* Mathematical Connections
* Number and Number Relationships
* Number Systems and Theory
* Computation and Estimation
* Patterns and Functions
* Algebra
* Statistics
* Probability
* Geometry
* Measurement

## FIFTH GRADE

STANDARD I: MATHEMATICS AS PROBLEM SOLVING

GOAL: All students will use problem solving strategies.

PERFORMANCE OBJECTIVES: All students will

1. identify problems, develop strategies to solve them, and explore applications to real life situations individually and cooperatively in groups.

2. use appropriate problem solving strategies, including
   a. asking questions,
   b. choosing an operation,
   c. using a concrete model/acting out,
   d. looking for a pattern,
   e. using probability and predicting,
   f. estimating,
   g. sketching, drawing, and diagramming (including tables/charts),
   h. guessing and checking,
   i. using a formula, equations, and proportions, and
   j. working backwards.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Calculator Exploration Problem. Use the digits represented by the month, date, and year of your birth and select any 5 digits. Use those digits to form a two-digit and a three-digit number so that their product is the largest possible. Then find the arrangement that gives the smallest product. Predict results and test.

2. The Sock Problem. As a group, select at least three strategies to solve this problem. Someone likes to wear socks of two colors. The person bought 3 pairs of one color and 2 pairs of the other color at a sale. (S)he put them all into a drawer together and, when rushed in the morning, took out two socks. Is (s)he more likely to get a matched pair or a mismatched pair more often? Will one color be more likely to occur than the other?

3. The Work Backwards Problem. There were 20 more 5th graders at the fair than there were fourth graders. 140 students from both grades went to the fair. How many fifth graders came to the fair?

STANDARD II: MATHEMATICS AS COMMUNICATION

GOAL: All students will communicate effectively about mathematics individually and cooperatively in groups.

PERFORMANCE OBJECTIVES: All students will

1. use the skills of reading, writing, speaking, listening, and viewing to interpret and evaluate mathematical ideas.

2. develop presentations using oral, written, concrete, pictorial, graphical, and algebraic methods.

3. discuss mathematical ideas, make predictions, and present arguments to support predictions.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The cross-curriculum project. Using content from science or social studies, collect, organize, and analyze the data and make a presentation to the class that uses oral, written or pictorial methods.

2. The math journal. Using a written entry in their mathematics journal to illustrate their understanding of a concept or a strategy.

STANDARD III: MATHEMATICS AS REASONING

GOAL: All students will understand and apply reasoning processes.

PERFORMANCE OBJECTIVES: All students will:

1. explore concrete materials to make and evaluate mathematical hypotheses and arguments.

2. demonstrate understanding of spatial relationships and proportions using concrete materials.

3. recognize and apply deductive and inductive reasoning.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Twin Prime Problem. Explore the numbers that occur between twin primes that are greater than 3. Look for twin primes to find examples, then make, test, and describe your predictions and your discoveries.

2. The Window Pane Problem. Determine the number of windowpanes in your classroom and discuss how many windowpanes might be in a school with 20 rooms? What other kinds of rooms are in schools besides classrooms? Do they have the same number of windows? Is this a calculator problem?

STANDARD IV: MATHEMATICAL CONNECTIONS

GOAL: All students will investigate connections within mathematics as well as between math and other content areas.

PERFORMANCE OBJECTIVES: All students will:

1. understand ways in which math topics are inter-related.

2. explore problems and describe results using a variety of response formats both individually and cooperatively in groups.

3. apply math reasoning and skills to solve problems across the curriculum.

4. understand that math has a valuable role in our culture and society.

PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The School Map Problem. Work with a group to make a scale drawing of an area of your school. Instead of using a tape measure, develop your own measuring instrument. Include a scale and compass rose.

STANDARD V: NUMBER AND NUMBER RELATIONSHIPS

GOAL: All students will increase their understanding of number and number relationships using concrete materials as appropriate.

PERFORMANCE OBJECTIVES: All students will:

1. identify, read, write, compare, and order numbers 0 - 1,000,000,000.

2. develop understanding of whole numbers, fractions, and decimals and the relationships between them.

3. demonstrate understanding of proportion, ratio, and percent.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Cookie Problem. The class party is coming and you are responsible for the cookies and punch. Find the recipes, determine the quantities you need, double or half them as necessary, and make a proposal to the rest of the class about the foods you plan to prepare.

STANDARD VI: NUMBER SYSTEMS AND THEORY

GOAL: All students will develop and apply number theory concepts (e.g., primes, factors, and multiples) in real-world and mathematical problem situations.

PERFORMANCE OBJECTIVES: All students will:

1. identify a need for numbers beyond whole numbers.

2. understand how the basic arithmetic operations are related to one another.

3. extend understanding of whole number operations to fractions and decimals.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Pet Problem. Half the students in the class like cats and the half like dogs. How many students like cats and dogs? If ¼ of the students do <u>not</u> like either dogs or cats, now how many students like dogs and cats?

2. The Twin Prime Problem extends understanding of prime numbers.

## STANDARD VII: COMPUTATION AND ESTIMATION

GOAL: All students will develop concepts underlying computation and estimation in various contexts both individually and in cooperative groups.

PERFORMANCE OBJECTIVES: All students will:

1. demonstrate their ability to add, subtract, multiply and divide up to six digits, using appropriate technology, regrouping, rounding, and estimation skills as appropriate.

2. identify, apply and solve equations using the commutative, associative, identity, and distributive properties.

3. compute using rational numbers and decimals.
   a. Write fractions for parts of regions or sets; find equivalent and lowest term fractions.
   b. Compare and order fractions and decimals.
   c. Add and subtract fractions and mixed numbers with like denominators.
   d. Find products of fractions and mixed numbers.
   e. Change percents to decimals to fractions.
   f. Identify a fraction's reciprocal and recognize their product is 1.
   g. Read, write, add and subtract decimals through 1,000ths.
   h. Round decimals to the nearest whole number and to the nearest 10th.
   i. Find products when one or both factors are decimals.
   j. Find quotients of decimals divided by a 1 digit whole number.
   k. Multiply and divide decimals by multiples of 10.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Pet Problem includes fractions.

2. The Playground Problem. The school has decided to build a new 100 yard square playground on property near the school. Each of the following activity areas must use <u>at least</u> the following percentages of land: play field 35%, basketball court 20%, climbing equipment 10%, swings 5%, sand area 5%. Use 1 centimeter graph paper to make a map. Label all areas and be prepared to tell why you made the playground as you did.

STANDARD VIII: PATTERNS AND FUNCTIONS

GOAL: All students will use patterns and functions to represent and solve problems.

PERFORMANCE OBJECTIVES: All students will:

1. identify and analyze a variety of patterns using:
   a. graphs.
   b. data tables.
   c. verbal descriptions.

2. create visual, verbal, or technological representations of patterns.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Cereal Problem. Collect the nutrition information labels from breakfast cereals and develop charts which allow you to compare the fat, sugar, calories, and protein amounts in each variety. Present your data to the class along with a recommendation for the "best" cereal.

STANDARD IX: ALGEBRA

GOAL: All students will explore algebraic concepts and processes to solve a variety of real-world and mathematical problems.

PERFORMANCE OBJECTIVES: All students will:

1. understand the concept of variable:
   a. as a placeholder for a specific unknown.
   b. as a representative of a range of values.

2. apply the concept of variable to solve problems.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Movie Problem. The class is going to the movies and needs to compute the cost of the tickets. Adults are $5.25 and students are $3.75. If there are 3 adults and 22 students, develop a formula to compute the answer.

STANDARD X: STATISTICS

GOAL: All students will understand, identify, collect, organize, and interpret data.

PERFORMANCE OBJECTIVES: All students will:

1. read and interpret graphs or tables for data analysis.

2. understand and follow a process of data collection, including:
   a. formulation of key questions.
   b. collection and organization of data.
   c. represent data using graphs and tables.
   d. communicate information using a variety of formats.

3. compute the mean, median, mode, and range of a set of numbers.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Endangered Species Problem. Use reference materials to identify endangered and non-endangered species. Develop a survey to assess whether people know which animals are endangered. Collect and organize the data using a graph or table. Present the information using print, video, or oral format.

2. The Sock Problem includes data collection and can include computation of the mode.

STANDARD XI: PROBABILITY

GOAL: All students will explore probability in real-world situations.

PERFORMANCE OBJECTIVES: All students will

1. devise and carry out experiments to determine probability of a single event.

2. predict events based on previous experiments or hypotheses.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Spinner Problem. Use a spinner divided into red and blue sections (¼ red and ¾ blue). One team is Red, the other Blue. Spin the spinner. The Red team scores 3 points if the pointer stops on red. The Blue team scores 1 point if it stops on blue. 24 points wins. Students will read the rules and decide whether they think it is fair, play the game and discuss fairness again.

STANDARD XII: GEOMETRY

GOAL: All students will identify, measure and classify common geometric figures.

PERFORMANCE OBJECTIVES: All students will

1. identify points, segments, and parallel, perpendicular, and intersecting lines.

2. identify and classify polygons according to the measure of their angles and the length and number of their sides.

3. identify and measure the radius and diameter of a circle.

4. identify and compare congruent and similar plane figures.

5. identify solid figures and count their vertices, faces, and edges.

6. identify plane figures having line and point (rotational) symmetry.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Candy Factory Problem. In your job at the Gum Drop Candy Company, you must decide how to send orders to customers. You can put 1-inch packages into boxes that are either a 1-foot cube or a 2-foot cube. It costs $4.00 to pack and ship the 1-foot cube and $24.00 to pack and ship the 2-foot cube. You have an order for 20,000 1-inch packages and 40,000 1-inch packages. How would you ship each package and why?

2. The Windowpane Problem can also be used to discover the area and perimeter of the window panes in your classroom.

STANDARD XIII: MEASUREMENT

GOAL: All students will use standard, metric, and invented systems of measurement.

PERFORMANCE OBJECTIVES: All students will

1. estimate and measure length using millimeters, centimeters, meters, kilometers, inch, foot, yard, mile, and invented measures.
2. find the perimeter and area of a given figure or real-life space.
3. find the volume or the capacity of a given container using metric, standard, and invented units.
4. estimate and measure the weight of various items using grams, kilograms, ounces, pounds, and invented units.
5. estimate and measure temperature using degrees (Celsius and Fahrenheit).
6. estimate and measure right, obtuse, and acute angles.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Monster Problem. A monster weighs between 2 and 6 pounds at birth. It is between 3 and 5 feet long. During the first year of its life, both its weight and height double each month. What size would the monster be on its first birthday? What shape would it be? Graph the growth over the 12 months and predict the size if the growth continues unchanged over the next year but is half as fast over the following year.

## SIXTH GRADE

STANDARD I: MATHEMATICS AS PROBLEM SOLVING

GOAL: All students will use problem solving strategies to solve problems.

PERFORMANCE OBJECTIVES: All students will

1. identify problems, develop strategies to solve them, and explore applications to real life situations individually and cooperatively in groups.

2. use appropriate problem solving strategies, including:
   a. asking questions.
   b. choosing an operation.
   c. using a concrete model/acting out.
   d. looking for a pattern.
   e. using probability and predicting.
   f. estimating.
   g. sketching, drawing, and diagramming (including tables/charts).
   h. guessing and checking.
   i. using a formula, equations, and proportions.
   j. working backward.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Recycling Center Problem. Use the following information to create at least 5 problems and use at least 3 different strategies to solve them. The problem: The store charges a 5 cent deposit on each aluminum can and gives it back when you return it. The recycling center pays $1.50 per pound for aluminum. Each can weighs about one-half ounce. You have two bags of cans. One with 30 and one with 34.

2. The Restaurant Problem. As a group, develop a cafe menu for breakfast. From this menu, you and two friends each pick out a good tasting, well-balanced meal. Compute the total cost of your meal and include a tip of about 15 cents for every dollar. Describe several combinations of change you could get from a $10 bill; a $20 bill. Make an organized list to show calculations and present this to the class.

STANDARD II: MATHEMATICS AS COMMUNICATION

GOAL: All students will communicate effectively about mathematics individually and cooperatively in groups.

PERFORMANCE OBJECTIVES: All students will

1. use the skills of reading, writing, speaking, listening, and viewing to interpret and evaluate mathematical ideas.

2. develop presentations using oral, written, concrete, pictorial, graphical, and algebraic methods.

3. keep a personal math journal of new concepts learned.

4. discuss mathematical ideas, make predictions, and present arguments to support predictions.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Restaurant Problem includes discussion and presentation to the class.

2. The Tourist Trap Problem includes opportunities for students to read, write, compute, and reason.

STANDARD III: MATHEMATICS AS REASONING

GOAL: All students will understand and apply reasoning processes.

PERFORMANCE OBJECTIVES: All students will

1. use concrete materials to make and evaluate mathematical hypotheses and arguments.

2. demonstrate understanding of spatial relationships and proportions using concrete materials.

3. recognize and apply deductive and inductive reasoning.

**NOTE**: Reasoning is difficult to teach as a separate topic at this grade level. It is better taught using the other contents through which one can develop and practice these objectives.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Trapezoid Problem. Draw 2 trapezoids and label each. Make two geometric figures inside the first trapezoid. Make the corresponding similar figures inside the second trapezoid. Explain why the trapezoids are similar and why the figures inside are also similar.

2. The Triangle Problem. Predict how many different size triangles you can find on the geoboard that are right triangles. Use the geoboard to verify your predictions.

STANDARD IV: MATHEMATICAL CONNECTIONS

GOAL: All students will investigate connections within mathematics as well as between math and other content areas.

PERFORMANCE OBJECTIVES: All students will

1. understand ways in which math topics are inter-related.

2. explore problems and describe results using a variety of response formats both individually and cooperatively in groups.

3. apply math reasoning and skills in projects and activities involving any content area.

4. understand that math has a valuable role in many different careers in our culture and society.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Tourist Trap Problem. Identify a tourist attraction in your area of study. Using road maps and other resource materials that you have requested by mail, develop an itinerary, including amount of time, mode and cost of transportation, type and cost of lodging, and estimate food and other expenses. Present your project to the class.

2. The Restaurant Problem connects health, math, and language arts.

STANDARD V: NUMBER AND NUMBER RELATIONSHIPS

GOAL: All students will demonstrate their understanding of number and number relationships, using concrete materials as appropriate.

PERFORMANCE OBJECTIVES: All students will

1. identify, read, write, compare, and order numbers 0 - 1,000,000,000by utilizing them in real-life, cross-curricular applications.
2. maintain understanding of whole numbers, fractions, and decimals and the relationships between them.
3. understand integers and scientific notation.
4. demonstrate understanding of proportion, ratio, and percent in real-life situations.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Survey Problem. Identify a topic, develop the questions and conduct a survey of the students in your grade. Develop a data table. (Students can choose their own topic, each group could choose a different topic or a different grade or population to survey.) Present your data to the class representing it as fractions, decimals, and percents, ratio, and proportion.
2. The Checkbook Problem involves integers.

STANDARD VI: NUMBER SYSTEMS AND THEORY

GOAL: All students will demonstrate and apply number theory concepts (e.g., primes, factors, and multiples) in real-world and mathematical problem situations.

PERFORMANCE OBJECTIVES: All students will

1. demonstrate a need for numbers beyond whole numbers.
2. demonstrate how the basic arithmetic operations are related another.
3. maintain and extend understanding of whole number operations to fractions, decimals and integers.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Checkbook Problem. When Bill checked his bank balance at an automatic teller machine, it was $75. He withdrew $50. The next day he deposited a check for $100 and withdrew $25. When he checked his balance a week later, it was -$100. Develop the checkbook register which explains what you think happened and be prepared to defend your answer.

## STANDARD VII: COMPUTATION AND ESTIMATION

GOAL: All students will maintain and extend concepts underlying computation and estimation in various contexts both individually and in cooperative groups.

PERFORMANCE OBJECTIVES: All students will

1. demonstrate their ability to add, subtract, multiply and divide up to six digits in real-life, cross-curricular projects and activities, using appropriate technology, regrouping, rounding, and estimation skills as appropriate.

2. identify, apply and solve equations using the commutative, associative, identity, and distributive properties.

3. compute using rational numbers and decimals.
   a. find equivalent fractions, compare and simplify fractions, and express common fractions as a mixed number.
   b. add and subtract common fractions with like and unlike denominators, and find the sum and difference of mixed numbers with regrouping.
   c. multiply common fractions and mixed numbers, find the reciprocal of a fraction or whole number, and divide common fractions and mixed numbers.
   d. read, write, and identify place value to the ten thousandths.
   e. compare and order decimals.
   f. round decimals to a given place value.
   g. express decimals as percents or fractions.

SAMPLE PROGRESS INDICATORS: All student will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The School Party Problem. You are in charge of ordering the soft drinks for the 6th grade party. You estimate that each person will drink 1 ½ cups. Each can makes 2 cups and costs $.18 to buy. Using your class for the number of students, estimate the number of cans you need to buy. Estimate the cost and prepare a report for the class which shows how much you will charge for the soft drinks if your goal is to raise money.

2. The Restaurant Problem includes opportunities to maintain and extend computation and estimation.

STANDARD VIII: PATTERNS AND FUNCTIONS

GOAL: All students will understand that you can use patterns and functions to represent and solve problems.

PERFORMANCE OBJECTIVES: All students will

1. create and analyze a variety of patterns using:
   a. graphs and data tables.
   b. verbal descriptions.

2. create visual, verbal, or technological representations of patterns.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Plant Growth Problem. Using your science class plant project, chart the growth of your plants at the end of 3 weeks and 6 weeks. From the chart, compute the mean, median, and the mode of the plants at 3 and 6 weeks and prepare a presentation of your data for the class.

2. The School Party Problem could be done with a chart or data table.

STANDARD IX: ALGEBRA

GOAL: All students will explore algebraic concepts and processes to solve a variety of real-world and mathematical problems.

PERFORMANCE OBJECTIVES: All students will

1. understand the concept of variable:
   a. as a placeholder for a specific unknown.
   b. as a representative of a range of values.

2. apply the concept of variable to solve problems.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Bookstore Problem. The Tall Tale Bookstore received a shipment of 500 copies of a bestseller. In 4 days all copies were sold. The manager wants to order enough copies of this novel to last 12 days. How many should he order? If you did not use an algebraic equation to help you solve this problem, set up an equation that relates the numbers 4, 12, and 500.

STANDARD X: STATISTICS

GOAL: All students will understand, identify, collect, organize, and interpret data.

PERFORMANCE OBJECTIVES: All students will

1. read and interpret graphs or tables for data analysis.

2. understand and follow the process of data collection, including:
   a. formulation of key questions.
   b. collection and organization of data.
   c. represent data using graphs and tables.
   d. communicate information using a variety of formats.

3. compute the mean, median, mode, and range of a set of numbers.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Plant Growth Problem could be enhanced by using statistical terms.

2. The Survey Problem involves a data collection process.

STANDARD XI: PROBABILITY

GOAL: All students will explore probability in real-world situations.

PERFORMANCE OBJECTIVES: All students will

1. devise and carry out experiments to determine probability of a single event.

2. predict events based on previous experiments or hypotheses.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Left-Handed Problem. What is the probability that the tenth person in line at the football game next Friday will be left-handed? Use at least 2 problem solving strategies to answer and prepare a report describing your strategies. (Will we find you checking handedness at the game on Friday night?)

2. The Coin Problem. Use a coin and create an experiment to test the probability that it will land on "heads."

STANDARD XII: GEOMETRY

GOAL: All students will solve geometric problems using measurement and classification.

PERFORMANCE OBJECTIVES: All students will

1. identify points, segments, and parallel, perpendicular, and intersecting lines.

2. identify and classify polygons according to the measure of their angles, the length and number of their sides.

3. identify and measure the radius and diameter of a circle.

4. identify and compare congruent and similar plane figures.

5. create solid figures and classify them according to their vertices, faces, and edges.

6. create plane figures having line and point (rotational) symmetry.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. How the Trapezoid and Triangle Problem utilizes geometry.

2. The Shape Problem. Using 1 centimeter graph paper, construct a six-sided irregular figure that has at least one acute, one obtuse, and one right angle. What is its perimeter and area?

STANDARD XIII: MEASUREMENT

GOAL: All students will demonstrate understanding of standard, metric, and invented units of measurement.

PERFORMANCE OBJECTIVES: All students will

1. understand and apply standard, metric, and invented units of measure for:
   a. length.
   b. area and perimeter.
   c. weight.
   d. capacity/volume
   e. temperature.

2. solve problems of measurement using:
   a. computation.
   b. estimation.
   c. technologies.
3. understand and apply standard and invented units of time to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Shape Problem includes measurement.

2. The Foot Problem. Use 1 centimeter graph paper and trace your foot. Estimate and then calculate the perimeter and area of your foot.

## SEVENTH/EIGHTH GRADE MATHEMATICS

### STANDARD I: MATHEMATICS AS PROBLEM SOLVING

GOAL: All students will use problem solving as a method of inquiry and application.

PERFORMANCE OBJECTIVES: All students will

1. use problem solving approaches to investigate and understand mathematical content, such as looking for patterns, guess and check, making tables, making lists
2. formulate problems from situations within and outside mathematics
3. develop and apply a variety of strategies to solve problems, with emphasis on multi-step and nonroutine problems
4. verify and interpret results with respect to the original problem situation;
5. generalize solutions and strategies to new problem situations
6. acquire confidence in using mathematics meaningfully
7. use calculators and computers to extend the curriculum
8. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The handshake problem. How many handshakes have to occur for 6 people to shake hands with each other. 1. Define a handshake - 2 people make one handshake, they do NOT have to shake hands with each other again. 2. Three people takes 3 handshakes, four people take 6 handshakes. If a table is made, a pattern is seen quickly.
2. Frog Simulation Problem. Build an origami frog, identify characteristics (such as jumping distance), organize and represent data (graph). Interpret the results, explain the results, and make conclusions.

## STANDARD II: MATHEMATICS AS COMMUNICATION

GOAL: All students will communicate mathematically.

PERFORMANCE OBJECTIVES: All students will

1. model situations using oral, written, concrete, pictorial, graphical, and algebraic methods.

2. reflect on and clarify their own thinking about mathematical ideas and situations.

3. develop common understanding of mathematical ideas, including the role of definitions.

4. use the skills of reading, listening, and viewing to interpret and evaluate mathematical ideas.

5. discuss mathematical ideas and make conjectures and convincing arguments.

6. learn the value of mathematical notation and its role in the development of mathematical ideas.

7. use technology to solve problems.

8. translate words into mathematical symbols.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The handshake problem can be discussed, written about in journals and graphed.

2. The frog simulation can be written up in a formal report format, including graphing the results.

3. Create a visual mathematical autobiography. On a piece of poster paper write your thoughts and views about mathematics without using words or numbers. The next step is have students write a word the symbol evoked in them. Third, the original student returns to their own poster and circle the word they wanted to convey. Students learn communication occurs in symbols, words and numbers.

STANDARD III: MATHEMATICAL REASONING

GOAL: All students will use reasoning.

PERFORMANCE OBJECTIVES: All students will

1. recognize and apply deductive and inductive reasoning
2. understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs
3. make and evaluate mathematical conjectures and arguments
4. validate their own thinking
5. recognize the pervasive power of reasoning and use reasoning as a part of mathematics.
6. use technology to solve problems

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Students will predict answers for the handshake or frog problems. They will then collect data, solve the problem and give reasons for their answers.
2. Fat Content Problem. Look at labels of several of your favorite foods. Identify the number of fat grams per serving. Use the Total grams per serving to find the percentage of fat by weight. Record results on a chart. It is recommended that less than 30% total calories should come from fat. There are 9 calories per gram of fat. Find the percentage of fat by calories. Ask: Are any product labels misleading? Does your diet meet the recommended 30% limit? What foods should you eat if you desire to gain/lose weight?

STANDARD IV: MATHEMATICAL CONNECTIONS

GOAL: All students will investigate mathematical connections.

PERFORMANCE OBJECTIVES: All students will

1. see mathematics as an integrated discipline

2. explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations

3. use a mathematical idea to further their understanding of other mathematical ideas

4. apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, psychology, science, and business

5. value the role of mathematics in our culture and society.

6. be introduced to the use of mathematics in various careers.

7. use technology to solve problems.

SAMPLE PROGRESS INDICATOR: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. River Float Problem. You are planning to float the Payette River but need to decide if the stream flow is appropriate to float safely. Research which levels are safe by calling a local outdoor agency. Take into account various modes of transportation on the river (tube, canoe, kayak, raft, etc.), report data, analyze data, draw conclusions and make decisions. Include discussion of units of measure, cost, distance of travel, locations of rivers, comparisons of rivers, environmental impacts on the river, how technology has changed floating rivers, etc.

STANDARD V: NUMBER AND NUMBER RELATIONSHIPS

GOAL: All students will develop number sense and number relationships.

PERFORMANCE OBJECTIVES: All students will

1. understand, represent, and use numbers in a variety of equivalent forms (integer, fraction,decimal, percent, exponential, and scientific notation) in real-world and mathematical problem situations

2. develop number sense for whole numbers, fractions, decimals, integers, and rational numbers

3. understand and apply ratios, proportions, and percents in a wide variety of situations

4. investigate relationships among fractions, decimals, and percents

5. represent numerical relationships in one- and two-dimensional graphs.

6. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Stock Market Project. Students spend $500 on one or two different stocks. Students identify how many shares they have bought. Students learn that a gain of 1 1/4 represents $1.25 gain per share. Compute total gain for their number of shares. Keep track of progress of the stock including total gain or loss by methods such as graphing or charting.

2. Solar System Information. Quantify distances from the sun to various planets from the solar system.

3. Compare the size of an amoeba to an elephant using scientific notation.

STANDARD VI: NUMBER SYSTEMS AND NUMBER THEORY

GOAL: All students will investigate the study of number systems and number theory.

PERFORMANCE OBJECTIVES: All students will

1. develop and use order relations for whole numbers, fractions, decimals, integers, and rational numbers, including order of operations.

2. extend their understanding of whole number operations, fractions, decimals, integers, and rational numbers

3. understand how the basic arithmetic operations are related to one another including the order of operations and properties (identity, commutative, distributive, associative).

4. develop and apply number theory concepts (such as primes, factors, and multiples) in real-world and mathematical problem situations

5. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Three Project. Using only 3's arrive at the numbers 0-20. Such as 3-3=0, 3/3=1, (3+3)/3=2 and so on.

2. Grade Project. Students will keep track of their grades using spreadsheets, graphs or calculators that follow the order of operations.

3. Area Models. Make as many rectangles as you can with 12 tiles (2 x 6, 6 x 2, 3 x 4, 4 x 3, etc). Compare this with 7 tiles. Extend with graphing the ordered pairs.

STANDARD VII: COMPUTATION AND ESTIMATION

GOAL: All students will, in various contexts, develop concepts underlying computation and estimation.

PERFORMANCE OBJECTIVES: All students will

1. compute with whole numbers, fractions, decimals, percents, integers, and rational numbers.

2. develop, analyze and explain computation and techniques for estimation

3. develop, analyze and explain methods for solving proportions

4. select and use an appropriate method for computing from among mental arithmetic, paper and pencil, calculator, and computer methods

5. use computation, estimation, and proportions to solve problems

6. use estimation to check the reasonableness of results.

7. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Refer to Standard VII for the Three Project, Grades and Area Models.

2. Walking Project. Plan your own walking trip to an interesting place that would take at least one million strides.

3. Estimate the number of basketballs it takes to cover your classroom.

4. Estimate the number of hours you have spent in school. Using a calculator, figure the exact amount. How close was your estimate?

STANDARD VIII: PATTERNS AND FUNCTIONS

GOAL: All students will explore patterns and functions.

PERFORMANCE OBJECTIVES: All students will

1. describe, extend, analyze, and create a wide variety of patterns

2. describe and represent relationships using tables, graphs, and rules

3. analyze functional relationships to explain how change in one quantity affects change in another

4. use patterns and functions to represent and solve problems.

5. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Handshake problem. Look for the pattern in the handshake problem. Graph it.

2. Graph the area model problem (see Standard VII.)

3. Age/Height/Weight Problem. Identify the ages, heights, and weights of ten people you know (choose people of different ages.) Graph the resulting ordered pairs (age, height; age, weight; height, weight) On each graph, label the points. Study the graphs. What relationships can you find?

STANDARD IX: ALGEBRA

GOAL: All students will explore algebraic concepts and processes.

PERFORMANCE OBJECTIVES: All students will

1. understand the concepts of variable, expressions, and equation
2. represent situations and number patterns with tables, graphs, verbal rules, and equations, and explore the interrelationships of these representations.
3. analyze tables and graphs to identify properties and relationships
4. develop confidence in solving linear equations using concrete, informal, and formal methods
5. investigate inequalities and nonlinear equations informally
6. apply algebraic methods to solve a variety of real-world mathematical problems.
7. solve equations
8. use set models
9. demonstrate the ability to manipulate the necessary algebraic symbols to solve problems.
10. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Use the Age/Height/Weight Problem.

2. Interpreting Graphs. Given four graphs, each on a coordinate plane, identify which refers to air temperature from midnight to evening; driving a car up to speed limit, braking, passing, stopping; etc.

3. Timeline. Construct a timeline using 10 events from your life. Figure the appropriate intervals for this timeline. Also predict 5 events for your timeline.

STANDARD X: STATISTICS

GOAL: All students will explore statistics in real world situations.

PERFORMANCE OBJECTIVES: All students will

1. systematically collect, organize, and describe data

2. compute measures of central tendency (mean, median, mode and range) in problem solving situations

3. construct, read, and interpret tables, charts and graphs

4. make inferences and convincing arguments based on data analysis

5. evaluate arguments based on data analysis

6. develop an appreciation for statistical methods as powerful means for decision making

7. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Refer to the Frog Problem.

2. The Average Eighth Grader. Collect the following data from the class: number of pets, number of siblings, number of hours of TV watched per week, number of minutes in the shower. Using a calculator or spreadsheet, compute the average eighth grader. Does this depict you? Why or why not? Write about it. What are the outliers? What do they cause the average to do? Can you predict the profile of an eighth grader outside of your class?

3. Refer to the Quantitative Literacy Program (see references).

STANDARD XI: PROBABILITY

GOAL: All students will explore probability in real world situations

PERFORMANCE OBJECTIVES: All students will

1. model situations by devising and carrying out experiment or simulations to determine probabilities

2. model situations by constructing a sample space to determine probabilities

3. understand the power of using a probability model through comparison of experimental results with mathematical expectations

4. make predictions based on experimental or mathematical probabilities

5. develop an understanding of the pervasive use of probability in the real world

6. use technology

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The Three Child Family. Figure the theoretical and experimental probability of having exactly one girl in a family of three children. Use simulation and record, analyze, interpret, and report results.

2. Figure the chance of rolling a seven with 2 dice.

STANDARD XII: GEOMETRY

GOAL: All students will study one, two and three dimensions in a variety of situations.

PERFORMANCE OBJECTIVES: All students will

1. identify, describe, compare, and classify geometric figures

2. visualize and represent geometric figures with special attention to developing spatial sense

3. explore transformations of geometric figures

4. represent and solve problems using geometric models

5. understand and apply geometric properties and relationships

6. develop an appreciation of geometry as a means of describing the physical words

7. know and use the Pythagorean Theorem

8. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. What is the largest size polygon you can construct on a 8 x 8 geoboard? Classify the shapes made. Compute the area of the shapes.

2. How many different 5 sided figures can you construct on an 8 x 8 geoboard? Classify the shapes you made. Compute area and perimeter of each shape.

STANDARD XIII: MEASUREMENT

GOAL: All students will experience extensive concrete experiences involving measurement.

PERFORMANCE OBJECTIVES: All students will

1. extend their understanding of the process of measurement

2. estimate, make, and use measurements to describe and compare phenomena

3. select appropriate units and tools to measure to the level of accuracy required in a particular situation

4. understand the structure and use of systems of measurement

5. extend their understanding of the concepts of perimeter, area, volume, angle measure, capacity, and weight/mass

6. develop the concepts of rates and other derived and indirect measurements

7. develop formulas and procedures for determining measures to solve problems

8. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Hand Problem. Trace your hand on a piece of paper. Estimate the perimeter and area of the resulting shape. Calculate actual perimeter and area. Compare your results with other students in the class. A graph might be an easy way to do this comparison but other methods might work also.

2. Measure your height in centimeters, graph and predict how much you will grow in the upcoming months. Plot a point every other month by actually measuring yourself.

3. Gas Mileage Problem. Is it efficient to drive an extra 5 miles to save 4 cents per gallon on a gallon of gas?

## IDAHO 8TH GRADE BENCHMARKS

The Idaho 8th grade benchmarks for 8th graders are intended to reflect the core of instruction and to apply across curriculum content areas. They demand mastery and the integrated application of basic skills and content. The assessment of these benchmarks will be included in the Statewide Testing Program. Students will be asked to demonstrate attainment of these benchmarks through specific performance tasks.

**An Idaho 8th Grader**

- **can communicate effectively.**
- **can access and organize knowledge, information, and technology effectively.**
- **can solve problems.**
- **can be creative and original.**
- **can determine quality.**
- **can be a collaborative worker.**
- **is an effective life-long learner.**

In the following section, a more complete statement and a list of traits of a good performance of each benchmark are presented. The benchmarks are not independent from each other, but are qualities of skilled workers and competent and active citizens. High quality performance of a task is likely to depend on the demonstration of traits from the full set of benchmarks.

1. **An Idaho 8th grader can communicate effectively in written, oral and multi-media forms (including audio and video recorded presentations; charts, graphs and visual aids; and computer enhanced presentations).**

   LIST OF TRAITS

   - Ideas and Content -- Communication is clear, focused, and interesting. It is appropriate for the audience and holds their attention. Relevant anecdotes and details enrich the central theme and demonstrate an understanding of the content.

- Organization and Format -- Communication is organized; and the format of the presentation enhances the central idea or theme. The order, structure, and presentation are well organized and address issues in a clear and direct manner.

- Voice -- The communication speaks appropriately and directly to the audience in a way that is individualistic, expressive and engaging.

- Form of Presentation -- The communication conveys the intended message in an interesting, precise, and natural way. Words, models, and symbols are used appropriately to enhance the presentation.

- Fluency -- The communication has flow and rhythm. Elements of communication are significantly developed and consistent.

- Conventions -- The communication involves all of the conventions of written and oral language that enhance the overall quality of the presentation.

2. **An Idaho 8th grader can access and organize knowledge, information, and technology effectively.**

LIST OF TRAITS

- Reading -- Written information is read with accuracy and understanding.

- Active Listening -- Verbal information is understood by the listener and evaluated for consistency and new understanding. Appropriate feedback is given to the speaker via summary comments and appropriate questioning.

- Sources of Knowledge and Information -- Relevant, comprehensive, and appropriate sources of content knowledge and information are identified and used in an efficient manner. Information technology is used in appropriate ways.

- Organization of Knowledge and Information -- Effective organization of knowledge and information is employed to enhance presentation and use. Clear criteria are employed to select relevant and accurate knowledge and information for presentation and use.

3. **An Idaho 8th grader can identify and describe problems, issues or projects and use knowledge, information, and technology to develop strategies for addressing and/or solving problems, issues or projects.**

LIST OF TRAITS

- Awareness and Identification -- Problems. issues or projects are clearly identified and understood.
- Components -- The components of problems, issues, or projects are presented using student and technologically generated figures, diagrams, maps, models, and other appropriate media.
- Development and Implementation Strategies -- Strategies for solving or addressing problems, issues or projects are identified, explored and evaluated. Clear and creative strategies, are selected and effectively implemented. In case of unexpected results, alternative strategies are explored.
- Verification of Results -- Results are related to prior knowledge and evaluated for reasonableness.

4. **An Idaho 8th grader can demonstrate creativity and originality in the design, production, and presentation of activities.**

LIST OF TRAITS

- Creativity and Originality -- Innovative applications and alternative methods in the design, production, and presentation of activities are developed and explored. Novel or creative applications of ideas or methods are used.
- Production and Presentation -- New understanding, methods, and products are generated. Presentation incorporates the appropriate use of current technology.

5. **An Idaho 8th grader can critique and evaluate the quality of work products and processes.**

LIST OF TRAITS

- Group and/or Self-evaluation -- Performances and work are critiqued by groups and individuals as appropriate.

- Strengths -- Evidence of ability, talent, and knowledge are identified within the performance and related to previous performances.

- Needs -- Areas for further improvement are identified. How improvements can be accomplished are discussed.

6. **An Idaho 8th grader can demonstrate the ability and skills to work collaboratively in a group activity.**

LIST OF TRAITS

- Behavior -- Behavior in group activities is self-evaluated and self-managed. Consideration for individual differences is demonstrated.

- Team Skills -- Active listening and participation skills are used in group activities.

- Feedback -- Constructive feedback on cooperative work is given and received.

- Group Functioning -- Group functioning is assessed and managed. Conflict resolution skills are used to solve group problems.

- Ethnic and Racial Differences -- Learn to live in a changing society with mutual respect and appreciation for others.

7. **An Idaho 8th grader demonstrates characteristics of an effective life-long learner.**

LIST OF TRAITS

- Vision -- Goals and priorities are identified.

- Self-esteem -- A positive vision for self and others is developed. A positive desire to learn is demonstrated.

- Initiative and Perseverance -- The desire and ability to plan and implement project activity over time and to work through to the conclusion of the project is demonstrated.

- Responsibility -- Responsibility for personal actions is demonstrated.

- Adaptability -- Changes and challenges encountered are dealt with in a positive way. Appropriate modifications to plans and actions in response to changing circumstances are made.

Following are example **8th Grade Performance Assessment** items.

1. The measure of one angle of a triangle is 60 degrees.

    a. List at least 5 combinations the other two angles could be.
    b. Draw at least two figures representing two of your answers.
    c. Describe in writing how well you believe you did on this problem.

2. A cube has a volume of 64 cubic centimeters.

    a. How long is each side of the cube?
    c. What is the surface area of this cube?
    b. Write a short paragraph telling how well you think you solved this problem.

3. You have the equation $X + Y = 6$.

    a. Describe all you can about this equation.
    b. Graph the equation on a XY coordinate graph.
    c. Write a short paragraph telling how well you think you solved this problem.

4. A table of temperatures for a very cold January morning in your town was found in the newspaper: 1 AM -2 degrees, 2 AM -2 degrees, 3 AM -2 degrees, 4 AM -1 degree, 5 AM 0 degrees, 6 AM -2 degrees, 7 AM -1 degree, 8 AM 0 degrees, 9 AM 3 degrees, 10 AM 7 degrees, 11 AM 11 degrees, and 12 noon 18 degrees.

    a. Illustrate these temperatures graphically in a graph of your choice.
    b. What was the total degree change in temperature from 1 AM to noon?
    c. What was the average temperature change per hour?
    d. Write a short paragraph telling how well you think you solved this problem.

5. A group of students pays $2.89 for a number of items. They each pay the same amount and that amount is equal to the number of students that paid their share. They each paid using the same number of coins, and three of the coins were the same.

    a. What were these three coins?
    b. How many total coins did each student use?
    c. What were the other coins?

[ ] Yes, I used a calculator with this problem; [ ] No, I did not use a calculator is a question asked at the end of each problem.

**IDAHO PERFORMANCE MATHEMATICS ASSESSMENT SCORING STANDARD**
**Shaded Areas Identify Other Suggested Performances Classroom Teachers Might Consider**

A score of '4' indicates that the student has advanced understanding of the situation given. The student recognizes the problem that is presented and internalizes it and decides what process would be best to solve the problem. The student demonstrates the higher order thinking skills that brings the process of determining a solution a step above the norm. The student then carries out the processes and is able to communicate them well on paper.

4 -- ADVANCED PROFICIENCY AT GRADE LEVEL

* Demonstrates advanced proficiency in basic skills
* Advanced understanding of situation
* Advanced communication skills in the subject area
* Demonstrates higher order thinking skills (synthesis, analysis, evaluation)
* Process is clear and appropriate
* Uses problem solving strategies effectively
* Errors are minimal or non-existent
* Solutions are correct
* Student is innovative and creative
* Works well with others when and where applicable
* Participates voluntarily in class activities when appropriate
* Able to evaluate self and adjust
* Appears willing to work equally or beyond expectations
* Takes advantage of the tools instrumental in "DOING" the work necessary to succeed



A score of '3' indicates that the student has an understanding of the situation given. The responses demonstrate a higher order level of thinking but not an advanced level. Problem solving strategies are shown correctly but there may be some surface errors that does not factor into correct solutions. Structure is well defined and adaptable. Demonstrated performance is proficient at grade level.

3 -- PROFICIENT AT GRADE LEVEL

* Demonstrates proficiency in basic skills
* Demonstrates understanding of situation
* Demonstrates effective communication skills in the subject area
* Uses higher order thinking skills (synthesis, analysis, evaluation)
* Process is adaptable
* Problem solving strategies are evident
* Some surface errors
* Solutions are defendable
* Well defined structured process
* Generally works well with others
* Participates in activities
* Demonstrates an ability to usually evaluate self
* Uses the appropriate mathematics tools effectively



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A score of '2' indicates that the student is on the way to developing proficiency in mathematics. There is limited evidence that the student understands a given situation. The student has difficulty in communicating information about the problem. Basic thinking skills and purpose are apparent but problem solving strategies and process development are limited. Frequent surface errors and lack of structure detract from proficient performance.

2 -- DEVELOPING TOWARD GRADE LEVEL PROFICIENCY

* Demonstrates developing proficiency in basic skills
* Limited evidence of understanding of situation
* Evidence of limited communication skills in subject area
* Demonstrates basic use of thinking skills
* Purpose may be evident but lacks development of process
* Limited use of problem solving strategies
* Frequent surface errors
* Seldom able to defend solutions
* Lacks structure
* Has difficulty working with others
* Poor participation in activities
* Does not always complete assigned work

A score of '1' indicates that the student is having difficulty with basic mathematics and implementing mathematical problem solving strategies. There is usually an attempt at solving the problem but basic thinking skill, structure, and process development is severely lacking. There are frequent errors, and the lack of communication skill is evident. Development toward proficiency at grade level is not evident.

1 -- MINIMUM DEVELOPMENT TOWARD PROFICIENCY AT GRADE LEVEL

* Demonstrates minimal development in basic skills
* Minimal evidence of understanding of situation
* Evidence of poor communication skills in subject area
* Demonstrates minimal use of basic thinking skills
* Lacks process development
* Minimal evidence of problem solving strategies
* Errors are common
* Incorrect solutions
* Minimal evidence of organization
* Ill-defined process
* Demonstrates a lack of ability to work with others
* Lacks motivation to participate in activities
* Shows evidence of not willing to do work

==========

NS -- NOT SCORABLE

* Blank
* Illegible





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## INTRODUCTION TO SECONDARY (9 - 12) MATHEMATICS

The goal of the State is to have all students achieve in the mathematics curriculum described in the content guide and framework. The important mathematical exit performance standards, as established by the State in the State's "Performance Based" education model, must be addressed in all mathematics courses.

This content guide and framework covers the critical concepts and basic skills that are inherent in the traditional courses offered at the high school level. The courses include:

| | |
|---|---|
| General Math | Applied Math I |
| Applied Math II | Pre-Algebra |
| Algebra I | Geometry |
| Algebra II | Trigonometry |
| Probability and Statistics | Integrated Mathematics |
| Discrete Mathematics | Advanced Mathematics (Pre-Calculus) |

Every mathematics course in grades 9 - 12 will address objectives from each of the fourteen standards included in this framework. In order to accomplish this, tedious computation and graphical representation by paper and pencil drill must be de-emphasized to the point that the use of technology (calculators, computers, etc.) will be used to perform these tasks at all levels of mathematics.

A variety of classroom organizational methods (including independent and small group work) are encouraged. At all levels of mathematics real-world problems should be included whenever possible. Each course should integrate from other areas of mathematics as well as other disciplines.

In order to help insure what should be learned at the 9 - 12 grade levels, instructors must deal significantly with:

* Mathematics as Problem Solving
* Mathematics as Communication
* Mathematics as Reasoning
* Mathematical Connections
* Algebra
* Functions
* Geometry from a Synthetic Perspective
* Geometry from an Algebraic Perspective
* Trigonometry
* Statistics
* Probability
* Discrete Mathematics
* Conceptual Underpinnings of Calculus
* Mathematical Structure

## SECONDARY MATHEMATICS 9 - 12

STANDARD I. MATHEMATICS AS PROBLEM SOLVING

GOAL: All students will refine and extend methods of mathematical problem solving.

PERFORMANCE OBJECTIVES: All students will

1. read and correctly interpret mathematical problem situations.
2. apply a variety of mathematical problem solving strategies to solve problems.
3. devise appropriate mathematical models to represent real world problem situations.
4. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. You need to cut some pieces of lumber into ten-foot lengths, but you left your tape measure at home. You have a four-foot long board and a two-foot long board.

   Show how you would use the lengths of the two-foot and four-foot boards to measure pieces of lumber to the required ten-foot lengths.

2. The toll to cross the bridge over the Snake River is $.50. One of the lanes has an automatic gate for exact change only. If the automatic gate will not accept pennies, find or show how many combinations of coins must the gate be programmed to accept.

3. Write a problem for a direct variation situation involving the work place. Explain how you know it is a direct variation. Write the equation for the situation.

STANDARD II. MATHEMATICS AS COMMUNICATION

GOAL: All students will develop language and symbolism to communicate mathematical ideas.

PERFORMANCE OBJECTIVES: All students will

1. express mathematical processes and relationships orally and in writing.

2. formulate mathematical definitions and express generalizations (potential theorems) discovered through investigation.

3. read written presentations of mathematics with understanding.

4. ask clarifying and extending questions related to mathematics they have read or heard about.

5. translate mathematical ideas to mathematical notation.

6. use technology to solve problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Describe the process for evaluating the expression 2 + 5 * 3.

2. Explain the difference between an independent and a dependent system of equations.

3. Students work in small groups. Look up the definitions of parabola, ellipse, hyperbola, and circle. See if you can derive their equations by using the definition and the distance formula. Report your results to the class.

STANDARD III. MATHEMATICS AS REASONING

GOAL: All students will use numerous and varied experiences to reinforce and extend logical reasoning skills.

PERFORMANCE OBJECTIVES: All students will

1. make and test conjectures.

2. formulate counter examples.

3. judge the validity of arguments.

4. construct simple valid arguments.

5. construct proofs for mathematical assertions, including indirect proofs and proofs by mathematical induction.

6. use technology to solve reasoning problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Think about the relationship "is greater than" (>). Can > work with the (a) reflexive property, (b) symmetric property, and (c) the transitive property? If it can work in a property, will it always work?

2. It was observed that $3^2$ is greater than 3 and $5^2$ is greater than 5. A conjecture was made that, "The square of any real number is greater than the number." Give a counter example to this conjecture.

3. Work in Groups. Each person in the group must understand the solution and be able to explain it to any person in class.

   At Whitewater High School, there are 500 students and 500 lockers, numbered 1 through 500. Suppose the first student opens each locker. Then the second student closes every second locker. The third student changes the state of every third locker (that is, closes the ones that were open and opens the ones that were closed). The fourth student changes the state of every fourth locker. This process continues until the 500th student changes the state of the 500th locker. Which lockers are open?

STANDARD IV. MATHEMATICAL CONNECTIONS

GOAL: All students will investigate the connections and interplay among various mathematical topics.

PERFORMANCE OBJECTIVES: All students will

1. recognize equivalent representations of the same concept.

2. relate procedures in one representation to procedures in an equivalent representation.

3. utilize and value the connections among mathematical topics.

4. utilize and value the connections between mathematics and other disciplines.

5. use technology to solve connections problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Simplify $2x + (4 + 3x)$ indicating use of, a) commutative, b) associative, c) distributive, and d) substitution.

2. Use a graphing utility to find the maximum and minimum values of $f(x,y) = 3x + 4y$ for the polygonal region determined by these inequalities; $x \leq 6, y \leq 3, x-3y \leq 9, 3x+y \leq 6$. Identify the polygon.

3. Explore the graphs of the trigonometric functions on your graphing utility. What are the angle measures for which the graphs of the sine and the cosecant functions are tangent to each other in the interval from -360 degrees to 360 degrees.

STANDARD V. ALGEBRA

GOAL: All students will continue the study of algebraic concepts and methods.

PERFORMANCE OBJECTIVES: All students will

1. represent situations that involve variable quantities with expressions, equations, inequalities, and matrices.

2. use tables and graphs as tools to interpret expressions, equations, and inequalities.

3. operate on expressions and matrices, and solve equations and inequalities.

4. demonstrate the power of mathematical abstraction and symbolism as applied to real-world situations.

5. use matrices to solve linear systems.

6. demonstrate technical facility with algebraic transformations, including techniques based on the theory of equations.

7. use technology to solve algebraic problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Direct Variation. The weight of an astronaut on the moon varies directly as his weight on earth. K is called the constant of variation. If Neil Armstrong with all his gear on weighed 360 pounds on earth and 60 pounds on the moon, then $360 = K(60)$ or $360/60 = K$. Find what the weight of a 200 pound man would be on the moon.

2. Using a graphing utility, the student enters the graph of any linear function. The student's task is to write the equation and show the graph of:

a. a line parallel to the given line;
b. a line that is steeper than the given line;
c. a line perpendicular to the given line.

Explain what causes each action.

3. Solve the system for the following equations using matrices:

$$4x-2y+3z=2$$
$$8x-3y+5z=8$$
$$7x-2y+4z=10$$

Check your answer.

STANDARD VI. FUNCTIONS

GOAL: All students will continue the study of functions.

PERFORMANCE OBJECTIVES: All students will

1. model real-world phenomena with a variety of functions.

2. represent and analyze relationships using tables, rules, and graphs.

3. translate among tabular, symbolic, and graphical representations of functions.

4. recognize that a variety of problem situations can be modeled by the same type of function.

5. analyze the effects of parameter changes on the graphs of functions.

6. demonstrate understanding of operations on, and the general properties and behavior of , classes of functions.

7. use technology to solve function problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Which mapping represents a function?

a) 2 --- 3
3 --- 0
5 --- 0
-1 --- -2

b) 3 --- 0
4 --- -3
4 --- 4
6 --- 7

2. The air pressure in the cabin of a jet fighter decreases as the plane ascends. Using a graphing utility, project what you think the air pressure would be at 60,000 feet based on the following data.

| Altitude (ft) | 10,000 | 20,000 | 30,000 | 40,000 | 50,000 |
|---|---|---|---|---|---|
| Air Pressure ($lb/in^2$) | 10.2 | 6.4 | 4.3 | 2.7 | 1.6 |

3. At lift-off, the space shuttle "Enterprise" has a constant acceleration, A, of 16.4 $ft./sec^2$. The initial velocity, $V_o$, due to the rotation of the earth is 1341 ft./sec. Use a graphing utility to graph the function $d(+)=V_oT + 1/2\ AT^2$ to determine the distance from earth for each time interval, T, after lift-off.

a) 30 seconds
b) 1 minute
c) 2 minutes
d) If the time the space shuttle is in flight doubles, does the distance traveled double? Explain.

## STANDARD VII. GEOMETRY FROM A SYNTHETIC PERSPECTIVE

GOAL: All students will continue the study of geometry of two and three dimensions.

PERFORMANCE OBJECTIVES: All students will

1. interpret and draw three-dimensional objects.
2. represent problem situations with geometric models and apply properties of figures.
3. classify figures in terms of congruence and similarity and apply these relationships.
4. deduce properties of, and relationships between, figures from given assumptions.
5. develop an understanding of an axiomatic system through investigating and comparing various geometries.
6. use technology to solve geometry problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. The area of a triangle is 124 cm. The length of the base is 31 cm. Find the height. Draw what the triangle looks like. Is more than one triangle possible?
2. Explain how the properties of a 3, 4, 5 triangle can be used to square the foundation of a rectangular building.
3. In right triangle ABC with hypotenuse AB = 32, M, N, P, Q, and R are midpoints of segments AB, AC, CB, BM, and AM, respectively. Find the perimeter of NPQR.

## STANDARD VIII. GEOMETRY FROM AN ALGEBRAIC PERSPECTIVE

GOAL: All students will study geometry of two and three dimensions from an algebraic point of view.

PERFORMANCE OBJECTIVES: All students will

1. translate between synthetic and coordinate representations.

2. deduce properties of figures using transformations and rising coordinates.

3. identify congruent and similar figures using transformations.

4. analyze properties of Euclidean transformations and relate translations to vectors.

5. determine properties of figures using vectors.

6. apply transformations, coordinates, and vectors in problems solving.

7. use technology to solve geometry problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Three rectangles each have the same area of six square units, but the lengths are four, six, and twelve. Find their widths. Is this an example of direct variation or indirect variation?

2. The vertex of the right angle of a right triangle is located at the origin with its other vertices at (0,12) and (5,0). Find the coordinates of the vertices of a similar triangle whose perimeter is three times that of the original triangle.

3. Translate an object twice; once through one pair of parallel lines and then through a different pair of parallel lines intersecting the first pair. What do you notice about the object?

## STANDARD IX. TRIGONOMETRY

GOAL: All students will study trigonometry.

PERFORMANCE OBJECTIVES: All students will

1. apply trigonometry to problem situations involving triangles.

2. explore periodic real-world phenomena using sine and cosine functions.

3. demonstrate an understanding of the connection between trigonometric and circular functions.

4. use circular functions to model periodic real-world phenomena.

5. apply general graphic techniques to trigonometric functions.

6. solve trigonometric equations and verify trigonometric identities.

7. demonstrate an understanding of the connections between trigonometric functions and polar coordinates, complex numbers, and series.

8. use technology to solve trigonometry problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. For a 3, 4, 5 right triangle find the sines of the two acute angles.

2. A car travels 500 meters along an inclined exit ramp whose angle to the ground has a measurement of 3 degrees. What was the vertical rise of the car in this distance?

3. On the fourth hole of the golf course, Tom Watson selects a five-iron. He estimates the distance to the pin to be 200 yards. Watson's swing provides an initial velocity of 150 ft./sec. to ball at an angle of 25 degrees above the horizontal. Use a graphing utility to determine if he will hit the hole. (Assume the ball is directed straight at the pin.)

## STANDARD X. STATISTICS

GOAL: All students will continue the study of data analysis and statistics.

PERFORMANCE OBJECTIVES: All students will

1. construct and draw inferences from charts, tables, and graphs that summarize data from real-world situations.

2. use curve-fitting to predict from data.

3. demonstrate the ability to apply measures of central tendency, variability, and correlation.

4. demonstrate an understanding of sampling and recognize its role in statistical claims.

5. design a statistical experiment to study a problem, conduct the experiment, and interpret and communicate the exit performance standards.

6. analyze the effects of data transformations on measures of central tendency and variability.

7. transform data to aid in data interpretation and prediction.

8. test hypotheses using appropriate statistics.

9. use technology to solve statistical problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Collect the scores from the newspaper showing the NFL games played Saturday and Sunday. Make a table of winning teams showing most points scored to fewest. Put the losing team's scores in a second column. Find, a) largest winning margin; b) lowest winning margin, and c) mean, median, and mode of each column.

2. Draw a scatter plot and find a prediction equation to show how typing speed and experience are related. Predict the typing speed of a student who has 12 weeks experience. Use a graphing utility to determine the result.

| Weeks Experience | 4 | 7 | 8 | 1 | 6 | 3 | 5 | 2 | 9 | 6 | 7 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Typing Speed (wpm) | 33 | 45 | 46 | 20 | 40 | 30 | 38 | 22 | 52 | 44 | 42 | 55 |

3. How do the women's records in the one-mile run compare to the men's during the last 50 years?

a) Consult an almanac or other reference to obtain the world record times for the women's mile run.

b) Enter the women's records into a statistical package.

c) Do these data show a linear trend? If so, find an equation for the line of best fit.

d) Repeat a - c for men's records. Predict the year that a woman will break the existing men's record in the mile run. Is the year near enough in the future for you to have faith in this extrapolation?

e) Write a brief report comparing and contrasting the performance of males and females in the mile run.

## STANDARD XI. PROBABILITY

GOAL: All students will continue the study of probability.

PERFORMANCE OBJECTIVES: All students will

1. use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty.

2. use simulations to estimate probabilities.

3. understand the concept of random variable.

4. create and interpret discrete probability distributions.

5. describe, in general terms, the normal curve and use its properties to answer questions about sets of data that are assumed to be normally distributed.

6. apply the concept of random variable to generate and interpret probability distributions including binomial, uniform, normal, and chi-square.

7. use technology to solve probability problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Find the probability that a coin tossed three times will always land "heads up." Toss three coins at once until three-in-a-row land heads up. How close was the real outcome to the probable one?

2. The U.S. History class is preparing for its final exam. From a class of 18 males and 12 females, how many study groups of 2 males and 3 females can be formed?

3. Consider a family with four children.

a) List all possible exit performance standards in the sample space (number of boys or girls in the family).

b) Let x equal the number of girls in the family. Assuming boys and girls are equally likely, list the pairs in the probability distribution for this experiment.

c) Make a histogram of the probability distribution.

d) Find the expected value of x.

4. a) If one card is drawn from a deck of cards, what is the probability that it is a "face" card?

b) If two people are cutting a deck of cards for high card and the first card drawn is a 7, what is the probability that the second person draws a higher card? (An ace is considered as the highest.)

c) Five people have each been dealt 5 cards for poker. One person has two "face" cards and another person has one. What is the probability that the next card will be a "face" card?

## STANDARD XII. DISCRETE MATHEMATICS

GOAL: All students will study topics from discrete mathematics.

PERFORMANCE OBJECTIVES: All students will

1. represent problem situations using discrete structures such as finite graphs, matrices, sequences, and recurrence relations.

2. represent and analyze finite graphs using matrices.

3. develop and analyze algorithms.

4. solve enumeration and finite probability problems.

5. represent and solve problems using linear programming and difference equations.

6. investigate problem situations that arise in connection with computer validation and application of algorithms.

7. use technology to solve discrete mathematics problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. a) Estimate an answer for: $\frac{3 + 4 \times 5}{2 \times 2 - 3}$

   b) Solve

   c) Use a calculator that accepts symbols of enclosure to work the problem.

2. A race car accelerates at a constant rate of speed. The table below shows the speed at one-second intervals. Using a graphing utility, find the speed of the race car after 10 seconds.

| Seconds | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| Speed (mph) | 119.9 | 128.6 | 137.3 | 146.0 |

3. Students make rings and necklaces in their spare time and sell all they make. Every week they have available 10,000 grams of metal and 20 hours to work. It takes 50 grams of metal to make a necklace and 20 grams of metal to make a ring. Each necklace takes 30 minutes to make and each bracelet takes 20 minutes to make. The profit of each necklace is $3.50, and the profit on each ring is $2.50. The students want to earn as much money as possible. What number of necklaces and rings should they make each week?

STANDARD XIII. CONCEPTUAL UNDERPINNINGS OF CALCULUS

GOAL: All students will informally explore calculus concepts from both graphical and numerical perspectives.

PERFORMANCE OBJECTIVES: All students will

1. determine maximum and minimum points of a graph and interpret the results in problem situations.

2. investigate limiting processes by examining infinite sequences and series and areas under curves.

3. demonstrate an understanding of the conceptual foundations of limit, area under a curve, rate of change, and slope of a tangent line, and their applications in other disciplines.

4. analyze graphs of polynomial, rational, and transcendental functions.

5. Use technology to solve calculus problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Compare the graph of $y = x^2$ to $y = \frac{1}{4}x^2 + 1$. Describe their similarities and differences.

2. A three- ounce arrow is shot upward with an initial velocity of 80 feet per second. The height of the arrow, h(t), in terms of the time since the arrow was released, t, is $h(t) = 80t - 16t^2$. Using a graphing utility, show the graph of the problem situation. How long after the arrow is released does it reach its maximum height? What is the height?

3. Suppose a four ounce potato takes five minutes to bake in a microwave oven, a seven ounce potato takes eight minutes to bake, a 10 ounce potato takes 10 minutes, and a 16 ounce potato takes 14 minutes.

   a) Find the average rate of change in baking time with respect to potato weight from four ounce to seven ounce. What is the meaning of your answer in terms of baking time?

   b) Find the average rate of change from 10 ounce to 16 ounce.

   c) Compare your answers to a) and b) in terms of baking time.

d) Assume the average rate of change from 16 ounces to 20 ounces is the same as from 10 ounces to 16 ounces. How long would it take to bake 20 ounces of potatoes?

## STANDARD XIV. MATHEMATICAL STRUCTURE

GOAL: All students will study mathematical structure.

PERFORMANCE OBJECTIVES: All students will

1. compare and contrast the real number system and its various subsystems in terms of structural characteristics.
2. demonstrate an understanding of the logic of algebraic procedures.
3. demonstrate that seemingly different mathematical systems may be essentially the same.
4. develop the complex number system and demonstrate facility with its operations.
5. prove elementary theorems within various mathematical structures, such as groups and fields.
6. understanding the nature and purpose of axiomatic systems.
7. use technology to solve mathematical structure problems.

SAMPLE PROGRESS INDICATORS: All students will demonstrate progress toward achieving proficiency in this standard by solving problems such as:

1. Draw a Venn diagram showing the following sets:

   $A = \{1, 2, 3, 4, 5\}$
   $B = \{2, 4, 6, 8\}$
   $C = \{3, 6, 9, 12\}$

   Shade $A \cap B$ with horizontal lines.

   Shade $B \cup C$ with vertical lines.

2. Using a graphing utility, find the area of the largest rectangular field that can be enclosed with 2000 feet of fencing.

3. a) Draw the quadrilateral with vertices $P = 6 + i, Q = 6 - i, P + Q$, and O,O.

b) What special type of parallelogram is this?

c) Determine the length of the longer diagonal of the parallelogram.

## SECONDARY EXIT PERFORMANCE STANDARDS

The Secondary Exit Performance Standards for high school graduates require mastery of basic skills and subject knowledge. Students' proficiency in these Performance Standards will be measured through a variety of tasks included in the Statewide Testing Program.

**An Idaho high school graduate**

- **communicates effectively.**
- **uses knowledge, information, and technology effectively.**
- **solves problems.**
- **is creative and original.**
- **determines quality.**
- **collaborates with others.**
- **is a lifelong learner.**

What follows is a more complete statement of each standard and a list of traits which describe each standard in more detail.

1. **An Idaho high school graduate communicates effectively in written, oral and multimedia forms (such as audio and video recorded presentations; charts, graphs and visual aids; and computer enhanced presentations).**

   LIST OF TRAITS

   - Ideas and Content -- The communication is clear, focused, interesting, and appropriate for the audience. Details and anecdotes demonstrate a command of the subject.
   - Organization -- The communication addresses issues clearly and directly.
   - Voice -- The communication speaks appropriately and directly to the audience in a way that is individualistic, expressive and engaging.

- Form -- The chosen form of communication conveys the intended message.
- Conventions -- The communication includes appropriate use of grammar, capitalization, punctuation, usage, spelling and paragraphing.

2. **An Idaho high school graduate locates, organizes, and uses knowledge, information, and technology effectively.**

LIST OF TRAITS

- Reading -- The student reads with accuracy and understanding.
- Active Listening -- The listener understands and evaluates verbal and nonverbal information and responds appropriately to the speaker.
- Identification of Sources -- Sources of knowledge and information are identified and used efficiently. Information technology is used appropriately.
- Organization of Information -- Information is effectively organized using clear criteria to select materials.

3. **An Idaho high school graduate identifies and describes problems or issues and develops effective strategies for addressing those concerns.**

LIST OF TRAITS

- Presentation of Components -- The issue is clearly described, using figures, diagrams, or models as appropriate.
- Development and Implementation Strategies -- Clear and effective strategies for solving or addressing problems or issues are identified, implemented, and evaluated.
- Verification of Results -- Results are related to prior knowledge and evaluated for reasonableness.

4. **An Idaho high school graduate demonstrates creativity and originality in the design, production, and presentation of activities.**

LIST OF TRAITS

- Creativity and Originality -- Innovative methods of design, production, and presentation are developed, leading to new understanding, methods, or products.

5. **An Idaho high school graduate critiques and evaluates the quality of work products and processes.**

LIST OF TRAITS

- Group and Self-evaluation -- Individuals and groups are able to critique their own work and the work of others.
- Identification of Strengths -- Evidence of ability, talent, and knowledge are identified within the performance and related to previous performances.
- Identification of Weaknesses -- Areas for further improvement are identified, and ideas for improvements are discussed.

6. **An Idaho high school graduate demonstrates the ability and skills to work collaboratively.**

LIST OF TRAITS

- Monitor Behavior -- In group activities, the individual monitors and evaluates his or her behavior and demonstrates consideration for individual differences.
- Team Skills -- Active listening and participation skills are used in group activities.
- Provide Feedback -- Constructive comments on cooperative work are given and received.
- Group Functioning -- How the group does its work is assessed and managed, with conflict resolution skills used to solve problems.

- Ethnic and Racial Differences -- Learn to live in a changing society with mutual respect and appreciation for others.

7. **An Idaho high school graduate demonstrates characteristics of an effective lifelong learner.**

LIST OF TRAITS

- Vision -- Goals and priorities are identified.
- Self-esteem -- A positive vision of self and others is developed. A positive desire to learn is demonstrated.
- Initiative and Perseverance -- The desire and ability to plan, implement, and conclude a project over time is demonstrated.
- Responsibility -- Responsibility for personal actions is demonstrated.
- Adaptability -- Changes and challenges are dealt with in a positive way. Plans and actions are modified appropriately in response to changing circumstances.
- Skills of Strategic Learner -- A variety of strategies for learning are developed and used.

## POSITION STATEMENTS

The National Council of Teachers of Mathematics, the Idaho Council of Teachers of Mathematics, or the Framework writing committee chosen by the State Department of Education endorse the following position statements.

## VOCABULARY POSITION STATEMENT

The use of mathematics terminology and symbols is an integral part of the study and application of mathematics at all levels. All teachers of mathematics should use correct mathematical terms in the process of their teaching. This approach, when applied consistently at all grade levels, will provide students with a much greater ability to progress. This would eliminate the confusion of language and enable students to more comfortably read mathematics texts and participate in mathematical dialogue. It is recommended that glossaries and appropriate mathematical dictionaries be utilized at each grade level.

## RESOURCE AVAILABILITY

Having the necessary resources including periodicals, professional journals, books, videos, software, and supplementals available for student use, is necessary for student success in reaching the goals for mathematics education. Students must have available to them the capability to access mathematics information for research purposes, independent study, and personal enjoyment.

## CALCULATOR USAGE

There are strong recommendations to integrate the use of calculators into the school mathematics program at all grade levels in classwork, homework, and evaluation. Although extensively used in society, calculators are used for less in schools, where they could free large amounts of time that students currently spend practicing computational drudgery. This gained time should be spent helping students to understand mathematics, develop reasoning and problem solving strategies, and, in general, use and apply mathematics. At each grade level every student should be taught how and when to use the calculator.

## STAFF DEVELOPMENT

We know more about how children learn today than ever before. We must take advantage of that knowledge and utilize all the tools that are appropriate to instruction. A variety of manipulatives, technology, and applications must be used in taking advantage of this new knowledge about learning.

In the current information age, the volume of knowledge and information increases rapidly. Increasing ones mathematical literacy (enumeracy) provides opportunities for more and better decision making. Our society is requiring a larger pool of literate mathematics people. To increase this pool we need to educate all students in the power, usefulness, and beauty of mathematics. Teachers must take advantage of staff development opportunities and stay current of curriculum, instruction, and assessment in mathematics so as to provide optimum opportunity for students to learn.

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Inquiries regarding compliance with this nondiscriminatory policy may be directed to Jerry L. Evans, State Superintendent of Public Instruction, 650 West State Street, Boise, Idaho 83720-3650, (208) 334-3300, or to the Director, Office of Civil Rights, Department of Education, Washington, D.C.